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Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington 6, D. C.

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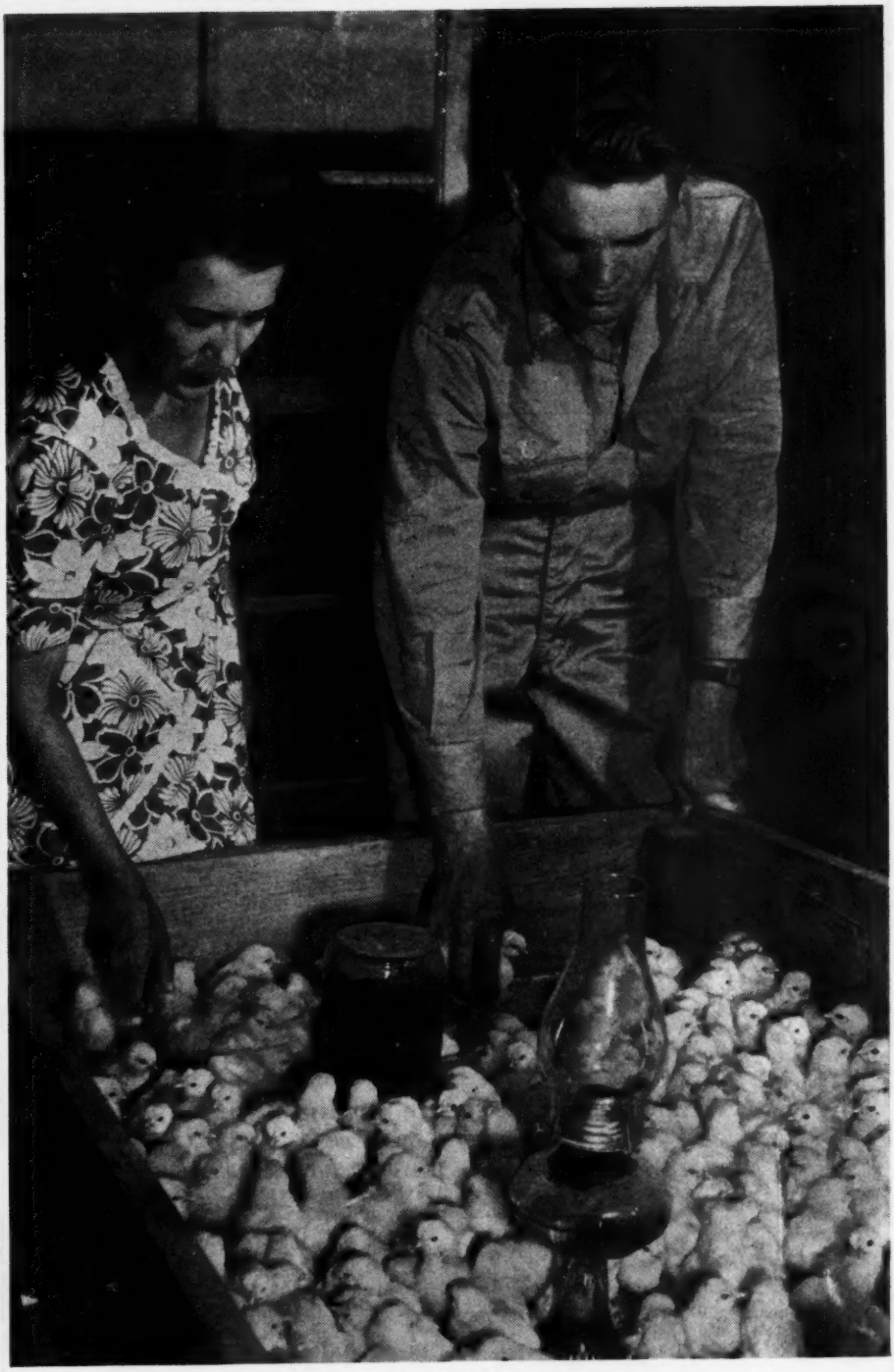

The Care of Things Small

Better Crops with PLANT FOOD

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VOL. XXXIII WASHINGTON, D. C., MAY 1949 No. 5

Let's join . . . .

The Lactic Litany

Jeff McDermid

INDEED, the gentle Moo-cow has jumped over the moon without leaving her pasture. The old brindle bossy on the dairy farm of my youth was a very simple animal—just a lumpy creature with a flimsy, dish-rag bag and a "nose all over the end of her face."

Similarly, the man who owned her and those who handled her lactic flow were relatively simple folk, seeking the main chance in the shortest possible time without benefit of science or health ordinances.

The accoutrement and working gear necessary to both producer and purveyor of her sustenance were likewise very elemental. On a majority of dairy farms they consisted of a box tie-stall, timothy hay in the manger, a squirt gun full of vile-smelling creosote fly-dope, a battered 10-quart pail, a make-shift stool, a tin strainer and a cheese-cloth to put in it, a cool spot in the cellar for storage, a flat tin skimmer, a rusty milk can, and a measuring cup—for the innocent consumers on the routes.

What few community cheese and butter factories we had were also meager in their facilities and indifferent to the rules of sanitation—if there were any. Farmers toted home slopping loads of skim milk and whey, redolent of varied odors and black with swarming flies. The human hand was stuck into the milk business almost up to the elbow, as it were.

Germs didn't fret us. Mister Pasteur, Dr. Koch, and Professor Bang were mere shadows on the path of progress and had but little to do with the dairy

business. The diseases of childhood were largely taken for granted, and sometimes parents even deliberately saw to it that their offspring would catch the fever and the rash so as to have it over and done with.

Middle-aged and old people scorned taking a glass of milk, claiming it was infant food. I suspect now that they had other and more powerful reasons not entirely removed from the palate and appetite.

OF course, to some extent in those simple times all manner of food was distributed with reckless indifference to the quality of its standards and its protection from spoilage and waste. Yet in the intervening years more progress has been made and more exacting care has been taken with the production and the dispensing of dairy foods than in almost any other line of eatables.

Foremost reason for this rapid and widespread improvement and complex mechanization within the milk industry can be traced to research by nutrition experts and the teaching of basic food and health relationships in public schools and colleges. In many cases milk was condemned, it is true, for its part in disease epidemics; but by and large, the position which the fruit of the cow has taken at the head of the "must" list for young and old has meant a positive force to expand and enlarge the opportunity for all who hung onto the cow's tail during her leap toward the moon.

You can begin right in the home stanchion of the modern triple-named pedigreed or high-grade bovine, check along the road to the icebox, and find wonders galore in machinery and equipment. If your present-day dairy cow's great grandmother could see what has happened on this streamlined milky way, she would forsooth be surprised enough to lose her cud.

Away back then, you couldn't insult a dairyman by saying that there was water or frogs in his milk, or make him uneasy about rumors of milk-borne maladies. Yet today there is no more sensitive or touchy set of food providers in the country than our dairy farmers and milk-plant managers. Anybody who attempts to stage a campaign with any remote allusions to possible harmful or suspicious reactions from dairy foods is soon in the midst of a battle royal. This is because they know the risks they are taking in handling a perishable, vulnerable food of major value, and they have a huge investment to insure compared to the days gone by.

Your dairy cow of traditional glory is the picture of rare content and smug complacency. She stands knee-deep in lush clover and wears a mask of bland, unworried ease. Not so the ones who feed her, groom her hide, and breed and milk her; or those many others who run the gadgets and the intakes. The price of liberty and free enterprise to them spells eternal vigilance—lest the bad bacteria creep in betimes and put a limp in the leap to the moon.

INTRICATE and vast as the supply and equipment picture within our modern milk world is, its inventory value in relation to the reasonable prices paid for such foods at retail bears a ratio now of 1 to 20. That is, the annual dollar volume of the principal dairy facilities is somewhere near $400,000,000. It is a very small item indeed when set beside equipment for other major consumer goods and vanishes to a speck alongside what we pay for war and peace. On the other hand, this equipment assures your family and mine ample menus of milk dishes every day at a purchase price of $8,000,000,000. And remember, too, that one quart of 4 per cent milk equals 6½ ounces of beefsteak in protein and 11 ounces in total energy.

Let's return then to that complacent cow, whose ancestors of our youth were lucky if they got a bite in the strawstack and a musty bed in the dark barn. Our modern moo-bossy surveys her home surroundings with noncha-

lance, being used to coddling and balanced meals. The boss snaps her into a fine steel stanchion or puts her into a shiny milking parlor. He uses a bright, non-rust milk pail, or taps her lactic flood with a quiet pulsating machine kept in scrupulous cleanliness.

In the nearest trading town, several country storekeepers have turned themselves into ration wizards and vitamin advisers, peddling the latest lore in brilliant bags to give the "foster mother" of the race her rightful share of everything from A to Z in vitamins, minerals, and all their complexes.

Down a side street in an office that smells like a hospital you seek the counsel of a veteran veterinarian, one who is wise to all the blood counts, the titers, the agglutinations, the injections, and the concoctions which science says are vital to the cow as a mother of a calf and the wet nurse (in absentia) to scores of rosy babies who never puke or run at the nose. He is a tyrant in regard to the dangers and the losses from brucellosis, X-disease, scours, bovine tuberculosis, hemorrhagic septicemia, and kindred curses and killers. His fees run into money sometimes but his services are as essential as those of the host who take the milk and turn it into human appetizers. (In the not-too-distant past my granddad was lucky if he got a vet for himself, let alone for any of the pesky cows.)

NOW that we have produced the milk and had it delivered to the nearest receiving station or manufacturing plant via tank car or refrigerated truck, we find that the job is just begun.

Remember that all through this complex business I hold no brief for the cow herself as a wise animal or one that is aware of her destiny. Personally, after close acquaintance with hundreds of old and young cows on the farm, in the barn, and on the fair circuit, I don't mind in the least confessing that I think she is a low-grade moron. I doubt if she has developed more brain power or acumen than the wild buffalo, or that she is in any sane way responsible for the progress her kind has made in fifty years. I had a cow stand on my foot for ten minutes once—a bare foot, too—and all the lurid language I poured into her fly-bitten ear was of no avail to make her shift.

Cows are like that now, in spite of all the fancy stuff that poets have written about them. Believe me, any improvements you see around the milk circuit belong to other brains and ambition than theirs. In fact, the milk-wagon horse has actually put more intelligence into the milk trade than any dairy cow that ever lived—and see what they've done to him, won't you?

Well, now the snappy boys in the white suits and the shiny faces take a mighty heave at the residue of the cow deposited on their doorsteps. When in due time we see 5 gallons of fresh whole milk transformed at will into 20 quarts of fluid milk, or else about 10 pints of 30 per cent cream, or 21 tall cans of evaporated milk, or about 11 quarts of ice cream, or, take your choice —4 pounds of American cheese, 5 pounds of Limburger, or 28 ounces of butter. This legerdemain is something to marvel about, both in the item of time and the element of cost. You can get any of the figures you want by approaching a lactic expert, but, sad to say, not all of the volume in all of the plants is up to the rigid standards which the leaders of the industry desire and demand. But again I say, they won't get it by asking the cow to shift her foot an inch. It's got to be done by their own initiative.

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Some Practical Considerations in the Addition of Micronutrients to Fertilizer*

By George H. Serviss

Cooperative G. L. F. Soil Building Service, Inc., Ithaca, New York

SOIL chemists, agronomists, and horticulturists today agree that we have a secondary and micronutrient problem. They also, with few exceptions, agree that supplying these nutrients, one way or another, will be much more important in the future than it is today. They do not agree as to how these nutrients should be supplied, how extensive the need is, or the rates of application. The ensuing discussion pertains to the problem particularly in the Northeast.

Some people seem to feel that the need for micronutrients is something new. It is the opinion of the writer that it is not and that the lack of one or more of these has been limiting crop yields on certain soils since the day they were first brought under cultivation.

Why the interest in them today? In the first place, agricultural research has progressed to the point where one can readily recognize plant abnormalities indicating a need for micronutrients. Such abnormalities formerly were attributed to the weather, plant disease, insects, or an act of God. In the second place, the need has been increased by two changes in production practices: First, by the decline in numbers, and in many cases total absence, of livestock on a high proportion of intensive cash crop farms. When there is no livestock there is no manure. Farmers have learned how to grow crops just as well without animal manures as with them, but there is no disputing the fact that animal manures provide substantial micronutrient insurance. This is especially true when a high proportion of the feed grain is produced in other areas, as is the case in the Northeast. The second change is in the greater intensiveness of agriculture. With high labor costs and high taxes, farmers strive for higher yields per acre. What was a sufficient supply of micronutrients for 5 tons of tomatoes or 100 bushels of potatoes is not enough for 15 tons of tomatoes or 400 bushels of potatoes. Farmers are applying increasing amounts of relatively pure salts of nitrogen, phosphorus, and potassium to obtain these desired, and in fact necessary, higher yields. This cannot help but increase the need for other nutrients.

Under continuous clean cultivation, leaching losses are heavier than under rotations including a grass sod. Liberal use of lime also has decreased the availability of some micronutrients, particularly manganese. One cannot overlook the fact that the present and potential needs are great enough to make it worthwhile for industry to supply them. Some manufacturers may dispute this last point since it very obviously complicates their manufacturing problems. However, most manufacturers realize that if they are to stay in business, the needs of agriculture must be met.

In supplying these micronutrients there seem to be three general methods. Since their use is still in the pioneering

* Presented at Washington, D. C., meeting of the Division of Chemistry, American Chemical Society, Sept. 1, 1948.

stage, this is not unusual. Probably the predominant method used by the mixed goods manufacturers in the Northeast is to keep the micronutrients out of the regular grades and supply them as separate materials. From a plant operation standpoint, this method cannot be criticized. This means, though, that the farmer must make extra trips over his land to apply them. He does not like this since the amounts are usually small and he could do a better job without extra work if they were included in his regular fertilizer.

The next method is the addition of micronutrients to regular grades at bagging. In plants where goods are cured to grade, this means a long ton which requires special tagging and extra weighing at bagging. During the peak of the shipping season it slows down production. Except during the rush period it is a very practical method. Some state laws apparently frown upon it even when everything is fully guaranteed. However, most such mixes must be used within a short time of bagging to avoid poor condition. In plants that mix several grades from bases at bagging, the long ton is not necessary, but the condition problem is even more acute.

A third procedure is the general addition of prophylactic or near prophylactic quantities of one or more micronutrients to regular grades at mixing time. From a plant operation standpoint this is the preferred procedure. Bins are not tied up with extra grades, there are no extra operations at bagging, the goods are cured, and there is no long-ton problem. A proprietary micronutrient mix or an individual's pet formula may be used. One thing is certain—no general agreement as to the make-up of such a mix or the general need for one can be obtained from Agricultural Experiment Station workers. The inclusion of micronutrients in fertilizer, backed by adequate Experiment Station research and strong Extension recommendations as is the case in Florida, and the amounts guaranteed would seem to be the best procedure. This takes care of the needs of agriculture, but presents a serious production problem in the multiplication of grades. The amounts included

Courtesy Campbell Soup Research Laboratories

Fig. 1. This spinach was grown on freehold sand with pH 6.8. Fertilizer was 1,000 lbs. per acre of 7-7-7. For the better spinach, 20 lbs. of manganese sulphate were added to each ton of fertilizer. The poorer spinach received no manganese.

are backed by guarantees and the farmer is protected.

There must be sufficient demand, though, from farmers before such a program will work, since these nutrients cannot be supplied in the recommended amounts free of charge. It is really a different matter than the inclusion of minute quantities in a "shot-gun" mix. The amounts included are substantial. This does not mean that the general addition of a "shot-gun" mix in small quantities is valueless in all cases. However, it cannot take care of real needs, and, in the amounts likely to be added, can do no more than stave off for a very short period, if at all, the time when larger quantities will have to be used. It also is well to recognize the fact that some soils have an inexhaustible supply of manganese, and there is one muck area in the Northeast where the zinc content is so high that it makes profitable crop production well-nigh impossible.

In the long run micronutrients will be supplied in accordance with research findings the same as the major nutrients. They present a different problem, however. In the case of the major plant foods—nitrogen, phosphoric acid, and potash—the farmer can usually overfertilize without any ill effects. In the case of some of the micronutrients, boron for instance, he cannot over-fertilize without detrimental effects as the range between enough and too much is small. Also, the proper amount for one crop may be too much for another. Since there are such wide variations in rates of application of the major plant foods, a strong educational program must accompany the use of micronutrients.

Courtesy Campbell Soup Research Laboratories

Fig. 2. The treatments for the tomatoes growing in pots were as follows: No. 61—No treatment; No. 62—3-12-12 fertilizer; No. 65—3-12-12 fertilizer plus 12 lbs. of borax and 20 lbs. of manganese sulphate per ton of fertilizer. The pH of soil is 5.8.

Some Recommendations

To illustrate the problem, consider some Experiment Station recommendations: New Jersey recommends the inclusion of 5 to 10 pounds of borax in each ton of fertilizer. Five pounds of borax costs about 15 cents, and because it is a strong recommendation, it can be easily serviced. However, the fertilizer industry is a low-margin industry, and not many 15-cent items can be added to a ton and still keep it competitive unless the farmer can easily see the value in the resulting crop. This he cannot always do with micronutrients.

For the production of canning beets in the area around Geneva, New York, the standard recommendation is 500 pounds of 5-10-10, 500 pounds of common salt, and 50 pounds of borax per acre. Since there are salt mines nearby, the salt can be obtained cheaply, and since the rate of application is high enough for even distribution with standard equipment, most farmers apply the salt separately. Some, though, want it mixed with the fertilizer, and all want the borax in the fertilizer. This means 200 pounds of borax per ton which certainly gets it out of the "shot-gun" micronutrient class. It is difficult to keep farmers from using any surplus on sensitive crops like beans.

New Jersey strongly recommends sufficient borax in an 0-1-1 ratio fertilizer to supply 20 to 30 pounds of borax per acre per year for alfalfa. New York and Pennsylvania recommend the same

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Mississippi Can Grow 100-bushel-per-acre Corn

By D. L. Williams

Coordinator of Research Information, State College, Mississippi

OUTSTANDING progress in producing high yields of corn has been made in Mississippi the last few years. The same basic factors and practices advocated as essential for these high yields the past three years still apply. It seems pertinent, however, to emphasize the necessity for more careful study and consideration of the following: (1) Raising the fertility level to support the maximum expected yield; (2) deepening and conditioning the root zone area for the plants to feed; and (3) conserving for more adequate use the supply of available moisture. It is believed that when these instructions are fully inaugurated, not only will higher dividends accrue for the efforts expended, but a good many hazards in production will be alleviated.

Adequate Moisture

Moisture is still the most acute problem confronting the producers of corn in Mississippi, even though there is a surplus available during our average corn-growing season. This is due in a large measure because so little consideration and emphasis have been given toward finding a solution to it. Someone has very aptly said: "We do not accept the natural fertility of the soil, but supplement it, so why should we continually gamble on the clouds that may or may not drop the moisture that gives life to our plants."

Our leading soil scientists tell us that in a humid climate approximately 152 barrels of water are required to produce a bushel of corn. All recognize the necessity for the plant to transpire a large number of pounds of water for each pound of dry matter produced. This amount varies according to the peculiar and varying conditions of climate, soil, and plant which exist during the growing season. The University of Washington Experiment Station in Bulletin 146 states: "The results of our investigations indicate that any condition which disturbs the normal life processes, be it soil, atmospheric, or pathological, increases the water requirement to just such a degree as it depresses the normal functionings of the plant."

On the basis of 300 pounds of water being required to produce one pound of dry matter, seemingly a fair assumption based on the numerous studies reviewed, it will require approximately 18.5 acre-inches of water to be utilized, or transpired, to produce 100 bushels of corn per acre in Mississippi. During the 4½-month period from April 1 to August 15, the period during which most corn is grown in Mississippi, we receive approximately 21 acre-inches of rainfall. These 21 inches plus 10.5 inches, the estimated amount of water already existing in the first 3 feet of soil on April 1 (20% moisture), give 31.5 inches available for a crop, 13 inches more than are required to produce 100 bushels. Whether or not this adequate and surplus moisture, which is available to us during the corn-growing season, can be conserved for use is the problem.

Ways of reducing this loss of moisture must be found if high yields of corn are to be obtained. Also it seems

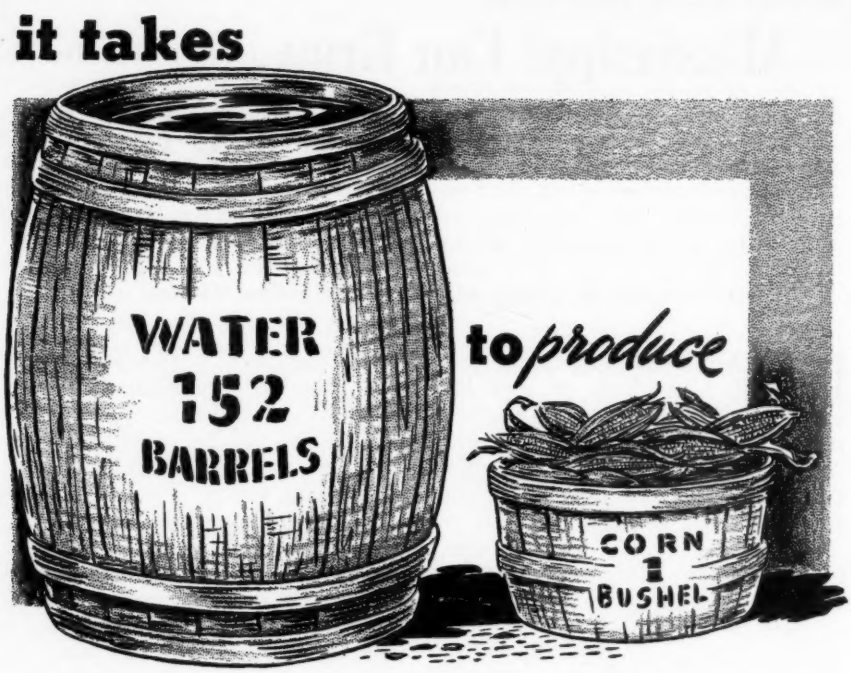

Fig. 1. The amount of water needed to produce one bushel of corn.

logical that yields far in excess of our present-day thinking may be achieved in the future if we can find a way to conserve for use a larger amount of the present moisture supply.

The Purdue University Experiment Station gives in its 60th Annual Report results of a 5-year study, 1942-46, in which an average increase of 7 bushels of corn for each inch of water saved was secured by conservation methods during the corn-growing season. It can be seen that after all other conditions are met a moisture supply may be the limiting factor. A moisture deficiency for only a short time in the most critical stage of the corn plant, which happens about the earing stage, can be disastrous.

Inasmuch as we, in Mississippi, produce corn in a surplus-moisture period, if we suffer too much, we need only charge it to poor moisture conservation and management. Table I presents suggestions which should help in the application of practices to increase the water supply of moisture for corn production. All of these practices, when properly used, have contributed substantially to the supply and more economical use of moisture.

Not overlooked here is the fact that with a thick stand of corn, plus the increased vigor due to heavy fertilization, etc., the total quantity of water required to produce a large number of pounds of dry matter actually will be stepped up, even though the requirement per unit of dry matter is much less. The heavy amount of vegetation quite often may help to add moisture as the following indicates: "Several years ago the late Professor A. R. Whitson of the Wisconsin Experiment Station told me how he was comparing the moisture content in the soil in a soybean plot with that in the uncropped plot. In August the soil moisture under the soybeans was actually higher than in the plot where no crops were growing. This did not seem reasonable, because we realized the soys were draw-

ing heavily upon the soil water and were evaporating much of it into the air, whereas no plants were using water in the fallow plot. At that time we had no explanation for the difference.

"In 1927 the answer came from a Russian named Lebedev who had spent his life studying soil moisture. He found that when the soil cooled during the night, moisture from the air would move into the soil in the early morning and forenoon hours after sunup while the soil was cooler than the rapidly warmed air above the soil. In some tests he found that the amount of water thus entering the soil was equal to about ⅓ of the rainfall in Odessa where tests were made.

"Everyone is familiar with the wet ice-water pitcher and water glass, or knows how cold water pipes in the basement will become wet and even drip on a warm summer day. The soil under a board will be more moist than the adjacent soil. This is not due entirely to the board preventing evaporation, but is due in part to the shading effect of the board in keeping the soil underneath it a bit cooler than the surrounding atmosphere, thus permitting moisture from the air to move into the soil under the board and condense. It is difficult to maintain moisture in a hot soil but it is easy to keep a cool soil moist."—(Geo. D. Scarseth, American Farm Research Assoc., Nov. '47—Better Crops With Plant Food.)

Plant-food Requirements

The results achieved by such a large number of Mississippi farmers in using for corn production the amount per acre of plant-food elements taken from the soil by a 100-bushel crop, warrant repeating this recommendation. It is as

TABLE I.—FACTORS AFFECTING THE SOIL WATER SUPPLY.

Factors affecting soil water supply	Practices found helpful in the conservation and economical use of soil water supply					
1. Preventing rainfall run-off	Terracing	Contour tillage	Increasing depth of root zone	Increase org. matter	Good stand veg. cover	Ridged culture
2. Increasing capacity and water-retaining power	Loosen root zone when compact	Improve structure	Increase vegetation	Inc. org. matter supply		
3. Curtailing evaporation	Good stand shade	Straw-litter mulch	Manure-mulch	Minimum cultivation	Weed control	
4. Decreasing transpiration ratio	Barnyard manure	Liberal chem. fert.	Select good land over poor land	Select varieties		
5. Increasing condensation	Good stand shade	Litter-mulch	Vegetative mulch	Increase organic matter		
6. Using water more efficiently	Time of planting	Select varieties				
7. Artificial application	Irrigation					

follows: Nitrogen 140 lbs.; phosphoric acid 50 lbs.; potash 100 lbs.

It is realized that it is difficult to secure, in many instances, the fertilizers necessary to make up this treatment. It is believed, however, that with proper planning this difficulty often can be overcome. The following combinations will give the required amounts of plant food:

(1) 6 tons Stable Manure
500 lbs. 6-8-8
300 lbs. Nitrate Soda or
150 lbs. Ammonium Nitrate

(2) 6 tons Stable Manure
Excellent Cover Crop
300 lbs. Basic Slag
100 lbs. Muriate Potash
200 lbs. Soda or
100 lbs. Ammonium Nitrate

(3) 6 tons Stable Manure
100 lbs. Superphosphate
100 lbs. Muriate Potash
500 lbs. Soda or
250 lbs. Ammonium Nitrate

(4) 900 lbs. Soda or
450 lbs. Ammonium Nitrate
300 lbs. Superphosphate or
600 lbs. Slag
200 lbs. Muriate Potash

(5) 3 tons Stable Manure
400 lbs. 6-10-5
200 lbs. 25% Potash
600 lbs. Soda or
300 lbs. Ammonium Nitrate

(6) 1300 lbs. 6-8-8
400 lbs. Soda or
200 lbs. Ammonium Nitrate

Cover crop allowances for nitrogen are: Excellent 45 lbs.; good 32 lbs.; fair 16 lbs.

The enlargement of the root-feeding area through the deep application of fertilizer has no doubt paid a higher dividend in the production of corn than has any other practice. This has been especially true during the extremely dry periods. With the fertilizer placed 8 to 10 inches in depth, the roots are attracted to that zone where moisture and plant food are sufficient to sustain necessary vigorous growth for an extended period. Shallow application or sidedressing may be almost worthless in very dry periods.

At the Ohio Experiment Station, Drs. Sayre and Yoder report: "A 100-bushel yield of corn required 142 lbs. of nitrogen per acre, 68 lbs. of which were taken up during each of the months of July and August." It is noted here that 136 pounds of nitrogen were used in 60 days, a period of maximum vegetative growth and critical need. It is doubtful whether this rate of nitrogen use could be accomplished in this short period anywhere with shallow application followed by limited rainfall.

The following statements are highly significant on the value of deep placement of fertilizer to meet the needs of plants during moisture deficiency periods:

"Increased corn yields resulted from

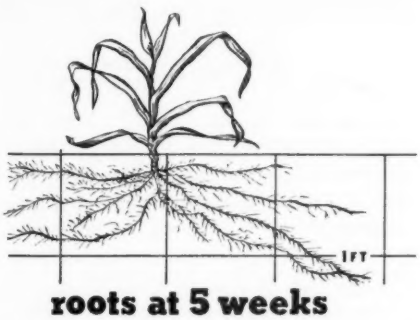

Fig. 2. Note how quickly the roots will reach the deeply placed fertilizer.

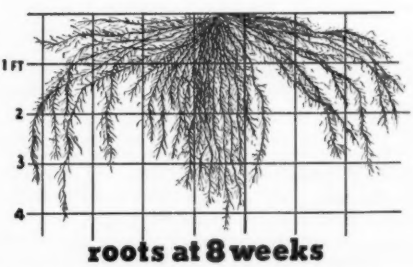

Fig. 3. Studies indicate that, under normal conditions, the soil depth to which the corn plant takes moisture is 5 feet. The roots reach this depth very early in the life of the plant. What damage would accrue through deep cultivation at this period? The "top inches" cultivated late do not contribute much toward the crop.

Fig. 4. R. B. Caldwell, Sr., farmer of Caledonia, Mississippi, discusses with his Vocational Agriculture Teacher, T. E. Ellis, whether to plant his one-acre field to corn again in 1949. During the past three years the yields have been as follows: 1946—104.5 bushels, 1947—108 bushels, 1948—116 bushels.

deep application of nitrogen with dry weather conditions. When adequate moisture was available there were no significant differences in favor of deep application."—Miss. Agr. Exp. Sta. Bull. 454.

"Recent studies have brought out certain advantages of deep application, often designated as 'plow-sole' application. By this method, the fertilizer is concentrated in hills in the bottom of the plow furrow. The fertilizer is then deep enough to be in moist soil during most of the growing season. In dry years, fertilizer is much more effective when applied deeply. The deep fertilizer may not become effective quite so early in the growth period, but it remains effective, if enough is used, until a good harvest is produced. There is also the minimum of soil fixation where the fertilizer is applied beyond the depth of cultivation. Mixing the soil and fertilizer by cultivation is a contributing cause of high fixation."—Dr. R. E. Stephenson—Oregon Agr. Exp. Sta.

"Drought damage to Missouri corn in the summer of 1947 represented a shortage of fertility because of dried, shallow surface soils overlying infertile clay subsoils and not because of a shortage of water for this crop. These facts were demonstrated by the absence of drought damage on the experimental plots given enough extra surface soil to double the normal depth of the soil. There was likewise no drought damage to the corn crop where liberal fertilizers were put down into the subsoil a few inches below the surface soil by means of the subsoiler on a TNT plow."—Dr. W. A. Albrecht, Chmn. Comm. on Soils—Univ. of Missouri.

All of the experimental evidence with which we are familiar indicates that higher yields are obtained if the corn is planted early, as early as possible after the danger of frost has passed and as soon as moisture conditions will permit. The month of June is considered too late for consistent maximum yields in Mississippi.

Land Preparation

Increasing the depth of the root zone, plus the proper placement of the needed fertility in this zone for its maximum

use by the plants, should demand our closest attention in land preparation. Extreme caution should be taken in conditioning the seedbed to see that the heavy rates of fertilizer applied will be far enough below the seed, when planted, so as not to interfere with proper germination. The following statements may suggest the importance of giving more consideration to land preparation: "Turning the soil upside down to great depths accomplishes nothing, when we plow just for the sake of plowing. However, when we plow to feed our crops, deep plowing takes on added significance. When lime and fertilizer are plowed down to the zone where roots feed when the topsoil becomes dry, we make productive soils out of poor soils."—C. M. Woodruff, Soils Dept., Columbia, Missouri.

V. A. Tiedjens, Director of the Virginia Truck Experiment Station, Norfolk, Virginia, said: "I have made the statement to growers that many soils in Tidewater, Virginia, should yield 300 bushels of shelled corn per acre. I realize that we have set our sight pretty high but I hope to demonstrate that with the lime requirement properly satisfied to a depth of two feet, with plowing at least 10 inches deep, and with a ton of fertilizer plowed under, it is possible to get these high yields."

There is ample evidence available to indicate that any time spent on cultivation beyond that of controlling weeds could be more profitably spent on some other farm activity. Oftentimes the destruction of roots by excessive cultivation causes damage to the crop. Mixing the soil and fertilizer by cultivation is a contributing cause of high fixation. There is evidence to indicate that corn on poor land responds better to cultivation than does corn on good land. This can be attributed largely to increased aeration provided for the poor land. A good deal of our cultivation, no doubt, could be dispensed with, profitably, as the following would indicate:

"In the poor-land series, good cultivation resulted in yields nearly 30 per cent larger, on the average, than were obtained under no cultivation. In the rich-land series the average yields from good cultivation and no cultivation were

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Fig. 5. Colored veteran Odis Lyons, Jr., shows his 100-bushel-corn project to his instructor, Harvey Rodman. This corn was planted on an acre of well-drained bottomland on April 19, 1948, and fertilized with 400 lbs. 33½% ammonium nitrate, 100 lbs. nitrate of soda, 200 lbs. 50% muriate of potash, and 300 lbs. 18% superphosphate. This acre of Dixie 17 corn has been estimated to produce over 125 bushels per acre. A total of 59 Negro vocational agriculture students exceeded the 100-bushel objective during 1948 in Mississippi.

The Soil and Human Health

By B. A. Rockwell

Pennsylvania Farm Bureau Cooperative Association, Harrisburg, Pennsylvania

IN the 1947 May issue of the *Coop. Review*, there appeared an article entitled, "Soil Is Our Life." One statement in this article read as follows: "Soil grows grass, cow eats grass, grass produces milk, baby drinks milk, baby thrives and grows, or does he?" The fact is, baby responds to the milk diet only to the degree in which the cow was able to put into her milk the growth factors which were in the grass and which the grass received from the soil. Cows have no biological apparatus to put ample levels of calcium and phosphorus in baby's milk, unless the food which the cow eats contains these elements. From this fact, the broader inference is that depleted soil could be responsible for dietary deficiencies and that food grown on such soil, even though quite abundantly consumed, could be the primary cause of a multitude of human diseases.

Since making this statement, the writer has been searching for results of authoritative research which would prove this inference. Finally, this search was rewarded by the discovery of a publication in which G. T. Wrench, M.D., of London has summarized and compiled in readable form the results of different researchers inquiring into the cause of health in contrast to the fragmentary conventional type of research—the various cause or causes of disease in general. Dr. Wrench's summary was published in 1938 and proves quite conclusively that the primary cause of disease is food.

Now to orient our thinking, let us quote the Doctor in his brief on the medical profession. "It should be clearly understood that the Doctor is one so saturated with peoples' illnesses and ailments that, if thoughtful, he is almost forced to look upon life as something burdened with these defects. One is caught in the meshes of the problems of disease from which one will not be able to free his mind for the rest of one's life. I sometimes used to walk about London with my eyes down and the question "Why" upon my lips until I saw the pictures of many maleficent objects of pathology upon the pavements, so vivid was the impression which the microscope and the post-mortem room made upon me. Here was indeed a truly prodigious opponent, the problem of disease, why man is so affected.

"After debating the question, why disease, why not health, again and again with my fellow students, I slowly came to a further question—why was it that the medical students were always presented with the sick and convalescent and never with the ultra healthy? The teaching was wholly one-sided. Moreover, the basis of our teaching was that which is dead from disease. We made no studies of the healthy, only the sick. To research in health was a complete reversal of the accustomed outlook. To propose reversing this was like asking one to stand on one's head to get the right point of view."

Dr. Wrench, with this upside down perspective, as it were, applied for scholarships in research, requesting in his applications to study the health of the healthiest people he could discover. Of course, he did not succeed in securing any such research scholarships. So, finally, he settled down as a regular practitioner, remained interested in very

healthy people, and always maintained an academic interest in the old question —health, why not?

By studying the flight of birds in the air, we have made machines which will carry us through the air faster than sound travels. Therefore, by studying the healthiest people in the world, we might learn how to become healthy ourselves.

If an individual were given the choice between excellent, vibrant health, able to work and generally enjoy life without riches, or continuous poor health with its accompanying miseries but with fabulous wealth at his disposal, he, if his intellect even aproached normal, would choose health in preference to sickness and riches. Health, perhaps, is the most precious of life's gifts, greatly to be desired by everyone. So, let us flip "Old Man Conventional" upside down, reverse our approach and for a few minutes, look in upon the cause of health rather than the causes of disease. The guinea pigs in this research, which is to be related, were the people of the State of Hunza situated in the northernmost part of India. In studying the reports of various travelers, doctors, and researchers who have mingled with the Hunza people, one conclusion is very obvious. The Hunza people were, at the time these observations and experiments were made, the world's most healthy people. So why this perfect health, magnificent physiques, and untiring vigor?

To better introduce the reader to these super-duper physical beings, we shall quote from reports: Colonel R. F. Schomberg, who for eight years had occasion to visit the Gilgit Agency and saw much of the Hunza said, "It is quite a usual thing for a Hunza man to walk 60 miles to Gilgit at one stretch, do his business, and return direct." Aurel Stein, the illustrious traveler, was amazed on the morning of June 25, 1903, to see a Hunza messenger return from a trip, having walked 287 miles since June 18, or exactly seven days. The messenger was quite fresh and undisturbed and did not consider what he had done unusual. In fact, the modern American man, after having walked a few city blocks, would show more fatigue. General Bruce of Mount Everest fame recounted in 1928, "I found the Hunza people very charming and perfectly companionable. They are as active as any people can possibly be." Captain C. Y. Morris, who explored the Hunza valleys and glaciers testified, "They were, I think, the most willing set of men with whom I ever traveled. They know neither fear nor the weariness which spoils the will."

Robert McCarrison, M.D., a practicing physician in the Hunza State for a number of years, wrote in his book, "My own experience provides an example of a race unsurpassed in perfection of physique and freedom from disease in general. The seven years I spent in their midst was confined chiefly to treatment of accidental lesions. I never saw a case of asthenic dyspepsia, of gastric or duodenal ulcer, of appendicitis, of mucus inflammation of bowels, or of cancer. Among these people, the abdomen, over-sensitive to nerve impressions, to fatigue, to anxiety or cold, was unknown. The consciousness of this part of their anatomy was related solely to the feeling of hunger. Indeed, their buoyant abdominal health, since my return to the west, provided a remarkable contrast to the dyspeptic, gastro-intestinal suffering from faulty food eating and the colonic lamentation of our highly civilized communities."

Mental speculation for a plausible answer to this physical supremacy would, no doubt, consider environment, heredity, food, and perhaps soil as contributing factors. Therefore, let us consider these factors in the order mentioned.

Environment

To start the inquiry into environment, as it pertains to health and vigor, two environmental extremes and their products should be considered. Climate is frequently upheld as a cause of disease or of health. Anyone who has

seen the perfect physique of a Bengal tiger in the heat of the African jungle and maybe also a polar bear in the frigid arctic will have to admit that each of these animals is a very rugged individual, even though the environment of each is very different. Those who have watched various races of man in different lands must doubt the factor of climate as of great importance in physique and health.

Now, let us turn our attention to the slum clearance project of Stockton-on-Tees in 1927, under the direction of Dr. G. M. McGonigle, local health officer. After the new housing project was completed, 152 families (710 individuals) were moved into their new homes, while 289 families (1,298 individuals) were left behind in the slum area. Here, then, were contrasting environments, the new and the old. Everyone believed that the transfer from the old to the new would be a betterment. But Dr. McGonigle watched. Much to his amazement, an odd thing was happening and the expected success did not materialize. Health instead of improving in the new area began to deteriorate, whereas that of those left behind in the slums did not. For the first five years, the death rate in the new area was 45% greater than it had been for the same group during the previous five years they were in the slums. The increase was not due to any peculiarity of infant mortality, epidemic, or other recognized cause. It was there just steadily throughout, and it represented an increase in the various age groups, from 0 to 10 and 10 to 65. There was also an increase of one third in stillbirths. This death rate then was real and beyond the probable extent of fortuitous variation.

To what was it due? The better housing? It seems absurd that something better should prove something worse. Finally, Dr. McGonigle came up with the answer, to wit: When the people moved from the slum area to the new area, they had to pay more for rent and had an average of 24% less cash to buy food. McGonigle was therefore, forced to the conclusion that the deterioration of food led to the deterioration of health. Here was a case where primary things were forgotten. Men live primarily by food, not by housing. The experiment emerged as an indictment of putting housing, which of course is good, prior to food in a policy of health. Both are good, but food is primary.

Schomberg, during his travels in India, not only visited the Hunza State but other areas which included the Ishkoman valley which is located about 60 miles west of Hunza. Quoting Schomberg, "The more I saw of the Ishkomanis, the more I was struck with their degeneracy; they were poor in physique and lacking in brains." So the difference of the Ishkomanis and the Hunza cannot be due to their environment, since the two people are not North and South, but East and West.

Heredity

It is now time to ponder the heredity factor and its bearing on disease. The medical faith goes back at least as far as Hippocrates and therefore, extends over a period of 23 centuries. During all this time, there has been an unfaltering belief in predestination, which means that if parents died from tuberculosis, it has been determined beforehand that the offspring is doomed to contract tuberculosis. The same sort of tradition applies to cancer and others. Certain blemishes and peculiarities, such as odd fingers or toes, albinism, mental weakness, and the inability of the blood to clot, are inherited, recurring again and again in families. Of course, the last two, feeble mindedness and haemophilia, are sex linked characters which are transmitted by mothers to sons. The point then that needs clarification is whether or not albinism, an extra toe or deformity, and mental weakness are afflictions, torments, or actual diseases. If we can correctly assume that germs, microbes, bacteria, and viruses incite disease, then how can

we square our thinking with the contention that an inherited deformity or mental weakness is a disease, since a fifth toe or a feeble mind contains no disease-producing germs?

Even cancer has been considered a disease, which belief is very questionable. Until recently, scientists believed that cancer cells did not increase by nuclear division like normal cells. Just recently, Dr. Wilton Earl, National Cancer Institute, Bethesda, Maryland, produced through nuclear division, a colony of cancer cells from one original cancer cell. This discovery indicates that cancer may not be a disease at all, but a mutation of cells. Mutations are usually caused by some external stress or force which always comes from without and never from within. Therefore, an individual starts life absolutely free from any internal cause of cancer.

There is much experimental evidence the results of which just about explode the predestination bubble, but for brevity the results of only one case will be related. This case deals with the Papworth sufferers from tuberculosis, mostly in the form of consumption of the lungs. All patients at the Papworth settlement had sputum pots which they used and the infected sputum was made innocuous. In Papworth, there were many married couples. The children of these tubercular parents lived in the settlement. The children were in frequent contact with tuberculosis but were protected first by the spitting pots and flasks to prevent mass infection, and, secondly, by a wholesome diet which maintained in the children the resistance to the disease. Now comes the outstanding fact.

After the Papworth settlement had thus existed for 20 years, not one child of these married couples ever developed any form of tuberculosis. Quoting Sir Pendrill in his 1936 report, "Our experience proves that no tubercular disease need be transmitted so long as village settlement conditions of housing and employment are properly utilized."

Any question of "heredity" is generally discredited. In face of this testimony to the resistance to tuberculosis brought about by a wholesome diet and other preventive measures, the textbooks put forward "predisposition" as a widely accepted medical tenet. So, if we assume that in the absence of germs, microbes, bacteria, etc., there would be no disease, then in the sense in which "inherited" is used in biology, there are no inherited diseases. An external cause is necessary.

Another interesting sidelight is to learn of the importance of a good start at the time a life is conceived. If per chance the sperm and ova cells originate from undernourished, sickly individuals, these cells will be weak and the new life which begins from their union will be weak. If the mother is undernourished during pregnancy, the child will be born proportionally weak. Regardless of how much we try, this weakness can never be completely overcome.

The Hunza women always eat a very wholesome diet, the character of this diet to be exposed later. Their children are strong at birth. At the time the observations were made, it was discovered that the Hunza mothers had been in the past, and still were, breast feeding their children for three years to further secure the excellent start. To become pregnant during lactation was considered unfair to the suckling child and socially had attached to it a sense of indecency. Briefly then, through improper living and more especially faulty food, deficient in life-giving factors, a general weakness is handed from parents to offsprings. Weak plants or animals are always more susceptible to disease than healthy, vigorous individuals, but the parent does not doom the offspring to cancer and tuberculosis. In short, owing to one's parents one can be sickly, but one cannot inherit any specific disease. The genes or birth factors of character know nothing of disease.

Food

We now are where the third factor, Food, should be investigated in our

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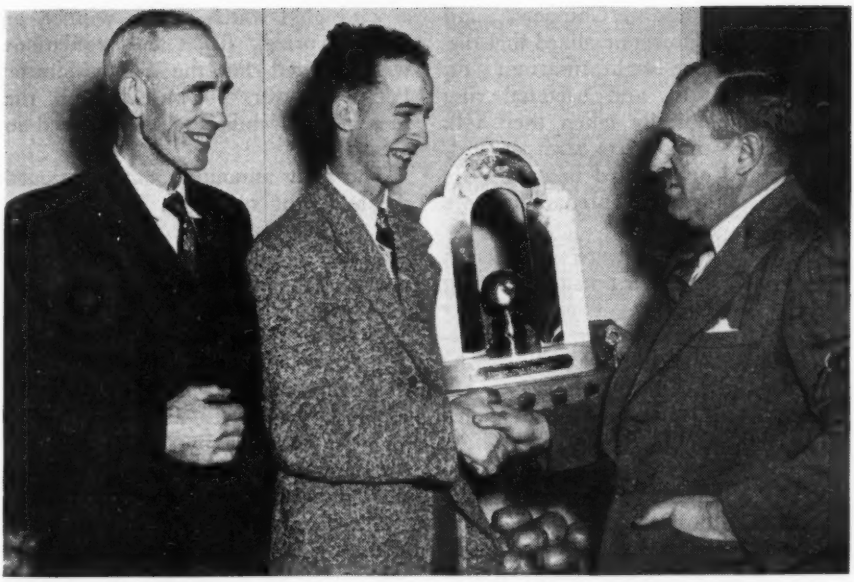

Fig. 1. The Grand Champion Potato Grower for Ontario in 1948 was Eric Gallagher (center) of Everett, South Simcoe County. His yield was 733 bushels per acre. He is pictured holding the trophy, while his father, Cecil Gallagher (left), looks on as R. E. Goodin congratulates him. The award is based on yield, quality, exhibit, and cooking test.

Five Years of 500-bushel Clubs

By R. E. Goodin

Potato Specialist, Ontario Department of Agriculture, Toronto, Ontario

IT was an evening in April 1943. A drizzle of rain was falling, and the air was cold and raw. A small group of potato growers met in the Agricultural Office at the Village of Alliston in Simcoe County, Ontario. Although a general meeting of growers for the area had been announced, very few attended. Perhaps the weather was not entirely to blame, for the farmers of the Alliston area had produced potatoes in large quantities, year after year, for at least a half a century.

These growers had experienced good years and some not so good. In the early Thirties they had sold high-quality potatoes at 25 cents for two 90-pound bags, loaded on cars. Some of the same growers had received six dollars a bag or more after World War I. Growers could recall when seed potato certification was introduced for the first time. They could remember when the Dooley variety was introduced and became generally grown for the late crop. As time went on, this variety was re-

placed by Katahdin, Chippewa, and Sebago. The growers realized that diseases, such as late blight, fusarium wilt, rhizoctonia, scab, and bacterial ring rot, had periodically taken their toll. They knew the insects such as leafhoppers and aphids had become more numerous and their depredations more costly.

But these growers were no different from growers in other potato-producing areas of Old Ontario. Their yields per acre in general had been on the decrease. With the average yield for the Province at less than 100 bushels per acre, how could anyone make money from potatoes, especially with high labour costs?

If the selling price was really substantial, the situation would be different. However, competition from areas where higher yields were obtained kept the market from reaching that desired price level. Although the meeting was called to discuss ways and means of improving the potato crop, the group easily might have broken up, because of disappointing attendance, and thus left indefinitely the situation as it was. But those present were concerned about sprayers, dusters, two-row planters, weeders, pickers, storage. They knew that almost every human being, which included the masses in our large consuming centres, would always need good potatoes; and Simcoe County soil, particularly in the vicinity of Alliston, should be capable of profitably producing high-quality tubers.

Perhaps the answer was more organic matter, more fertilizer, better seed, improved cultural methods, and protection of the growing crop. Finally, as an encouragement to adopt these modern approved methods, a 400-bushel club was suggested as a project of the local Crop Improvement Association. The idea of a crop objective seemed to appeal. Why not 500 bushels per acre? The higher objective sounded well, although most growers felt that it couldn't be achieved. A representative of a commercial company offered a solid gold watch to the winner, as the first prize. Rules and regulations were drafted for the South Simcoe Potato Growers 500-bushel Club, the first of such clubs to be organized in Canada.

The early announcement mentioned the following objective: "It is the desire of the committee to bring about as great an increase per acre as it is possible to obtain."

During the season, growers vied with each other; they enquired about methods being used by fellow competitors; they ventured on naming the prize winners; and visualized individual yields. At the same time, close observation and attention were given to their own crops. Neighbours took an interest. Visitors to the area were impressed with the friendly atmosphere and the lively attitudes of competitors. Finally, measurements and weights were taken; yields were calculated; and results made known at a well-attended potato growers' banquet. Three growers from a total of 24 had obtained yields slightly over the objective of 500 bushels.

Fame soon spread, and it carried a challenge. Enthusiasm was spontaneous. Growers in other areas were anxious to try their skills at producing maximum amounts of "Man's Greatest Food," on their own farms. As a result, growers in 11 counties and districts organized similar competitions, and 194 competitors finished off that fall with an average yield of 330 bushels per acre.

The experience gained fascinated those taking part. Winners counted their blessings, and non-winners firmly resolved "to do better next time." In the meantime, others were making preparation, and so the next year brought more competitions and more interest. Momentum increased with each succeeding year. Although statistics in this case cannot adequately convey the over-all progress in potato production, the following briefly summarizes further development.

Year	No. over 500 bu. per A.	No. over 600 bu. per A.	No. over 700 bu. per A.
1943....	3	.....	.....
1944....	17	4	.....
1945....	3	2	.....
1946....	52	6	.....
1947....	41	12	1
1948....	69	18	2

The number of both clubs and competitors grew, as indicated by the following summary:

Year	No. of clubs completing contests	No. of competitors completing contests	Average yield per acre
1943....	2	36	— bu.
1944....	11	194	330 "
1945....	12	207	266 "
1946....	15	282	379 "
1947....	16	275	392 "
1948....	21	394	392 "

In addition to prizes for quantity, several clubs featured substantial awards for quality and selected exhibits. Following the product one step further towards the consumer, one club allotted a portion of their prize money last year to "condition of potatoes in storage." Cost of production records are kept by many and Individual Certificates of Merit are provided to each grower attaining the objective.

Potato growers' annual banquets have become popular features in the life of several potato-growing communities. Eleven such friendly get-togethers were held in 1947, with an attendance of approximately 1,500. These occasions provide opportunities for presentation of prizes, and the programme usually features outstanding speakers and entertainment. Top growers in county and district contests are eligible to compete for championship honours for the Province, based on yield per acre, quality, and selection of an exhibit consisting of one bushel.

As might be expected, several important improvements in cultural and fertilizer practices have been developed as a result of these competitions. Many good growers, after plowing their clover sod in preparation for the potato crop, seed it with fall rye. Usually the rye is fertilized with 200 to 300 pounds of

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Fig. 2. Planting a crop in South Simcoe County at Alliston. J. Nicol Wilson, owner, is on the tractor with his son. In 1947, Mr. Wilson planted more than 500 acres on a custom basis with his two-row planter.

What Is Happening to Wisconsin Soils?

By C. J. Chapman

Soils Department, University of Wisconsin, Madison, Wisconsin

WISCONSIN farmers have been practicing a system of intensive cropping for a period of nearly 100 years. Our soils have been steadily losing plant food in the sale of dairy products, livestock, and cash crops. Not only have we been cashing in on our soil's fertility, but we have been losing our precious topsoil at an alarming rate. Those of us who years ago had caught a glimpse of what was happening to the soils of Wisconsin became greatly concerned. We were seriously asking the question "How long will the soil on our farms hold out at the rate we are mining and losing it?"

In the early days of my extension work in Wisconsin I used to make the statement that after another 50 years of farming at the rate at which soil fertility was being used up and the actual soil being lost, there wouldn't be any soil or farms left in the hilly areas of western Wisconsin, unless something was done about it. And yet, many of our agricultural leaders in those early days were complacently telling Wisconsin farmers that they had nothing to worry about—that our great livestock system of farming would maintain the productiveness of their farms. "Manure," "Legumes," "Crop Rotation"—all those words they thought were synonymous with a system of soil fertility maintenance and permanent agriculture.

But even where losses of soil by erosion had not been too severe, there still had been an insidious and continuous drain on the fertility of the soil. We did shift from a system of wheat farming to a system of livestock farming. But what happened as a result of this shift? Simply this: we broke up more of our hillsides; we grew more and more corn to feed our beef cattle and hogs, more and more corn to fill our silos and to feed our dairy herds. We did rotate our crops, but in the corn-grain-clover program of growing feed for our livestock, it was still true that two out of three or four years our fields were wide open to the forces of wind and water erosion.

Thirty years ago I was making such statements as this: "Something must be done to awaken Wisconsin farmers to the seriousness of their soil problems and get them started on a program of soil building and fertility maintenance." "I predict that the future prosperity of Wisconsin farmers will be measured by the extent to which they follow out a soil-improvement program." Chapman, people used to say, was an alarmist and a calamity preacher, overly excited about the need for fertilizers. His talks, they said, were about 90% enthusiasm with few facts to support his statements.

But even in those days I did have plenty of supporting evidence from our demonstrations to show that fertilizers could be used with profit; and it is certainly true that the thousands of field demonstrations which we have since carried out have given us positive proof that commercial fertilizer can be used with profit on a high percentage of the farms in Wisconsin.

Our program of whole-farm demon-

Fig. 1. The deep placement of liberal amounts of high-nitrogen fertilizer is recommended where corn or other deep-rooted crops are to be grown on land of low fertility or where little or no manure is available. Here on the Paul Bartels farm in Grant Co., Wis., the application of 800 lbs. 8-8-8 per acre with an attachment on the plow plus starter fertilizer 2-12-6 in the hill resulted in a yield of 108.7 bushels per acre as contrasted with 76.0 bushels when starter fertilizer only (2-12-6) was applied. At $1.40 per bushel, the extra 32 bushels made a profit of $25.74 over and above the cost of the fertilizer.

strations, set up in cooperation with T.V.A. in some 35 Wisconsin counties on approximately 375 farms, has given us a great bank of factual evidence to support our recommendations.

The findings of our experiment stations at Hancock, Marshfield, Spooner, and Ashland Junction, as well as the more recent results secured from experimental plots located in Clark, Barron, and Dodge Counties, have likewise given us a mass of irrefutable evidence and show conclusively that our soils are running low in their reserves of available plant food.

Not only have we been losing phosphorus in the sale of milk, livestock, and cash crops, but potash and nitrogen have been wasted and lost from our livestock farms in the careless handling of stable manure. The chemist tells us that approximately 75% of all potash and nearly 50% of the nitrogen in animal manures are contained in the urine. Loss and waste of liquid manure result in tremendous losses of potash and nitrogen. When added together, the combined loss incurred in the feeding transaction plus losses in handling of manure amount to approximately 60% of the nitrogen, 50% of the phosphorus, and 55% of the potash contained in crops harvested and fed to livestock. The organic matter reserves of our soils in Wisconsin have been and still are being depleted.

Based on the results of the hundreds and thousands of soil tests and field demonstrations, we now are recommending that potash be used in addition to phosphates for grain and legume seedings on a high percentage of Wisconsin soils.

Soil and Field Tests Show Need for Potash

The average of 166,464 soil tests made in our laboratories during the past five years showed 59% of these samples to be acid, 71% deficient in available phosphorus, and 79% deficient in available potassium. Thus it

Fig. 2. Some nitrogen can be used with profit on at least 50% of the 3¼ million acres of grain grown on Wisconsin farms, provided adequate amounts of phosphate, potash, and lime are applied. Test plots on several hundred farms during the past 4 years show that there is less danger of lodging with the new stiff-strawed, disease-resisting varieties of oats. Seedings of clover and alfalfa made a strong, vigorous start in the early part of the season on the "high level" fertility plots and were able to withstand considerable competition with the nitrogen-treated nurse crop. Pictured is a field of Clinton oats on the Green County Hospital Farm, Monroe, Wis., where with nitrogen the 0-20-20 plot yielded 124.6 bushels per acre and no lodging occurred.

Yields: 0-20-20 at 500 lbs. plus ammonium nitrate at 100 lbs. = 124.6 bu. per acre
0-20-20 at 500 lbs. only = 100.5 " " "
No fertilizer = 80.3 " " "

appears that nearly 60% of our farm lands are still in need of lime, even though Wisconsin farmers have applied over 16 million tons of liming materials during the past 15 years. Furthermore, these soil tests now indicate a relatively greater need for potash than for phosphate.

Our field demonstrations with fertilizers support the findings of our soil tests. In Table 1 we see the average of 735 grain demonstrations carried out over a period of 16 years, and here we note that even where the entire cost of the fertilizer is charged against the increase in the yield of grain, there is

TABLE 1.—AVERAGE OF 735 GRAIN DEMONSTRATIONS (16 YEARS INCL. 1948) WHERE AVERAGE YIELDS OF 0-20-0, 0-20-10 & 0-20-20 PLOTS ARE COMPARED. (YIELD DATA INCLUDE THE PLOTS FOR 1945, 46, 47 & 48 WHERE AMMONIUM NITRATE WAS APPLIED AS A TOPDRESSING IN ADDITION TO THE 0-20-0 AND 0-20-20 TREATMENTS.)

Treatment	Average rate per acre lbs.	Average yield bu.	Increase yield bu.	Average yield straw lbs.	Increase straw lbs.	Value of inc. grain, & straw	Cost of fertilizer	Net profit per acre
0–20–0.....	235	53.06	10.57	2,551	506	$10.24	$3.56	$6.68
3 (0–20–10).... (0–20–20)....	235	59.12	16.63	2,760	715	15.92	5.18	10.74
Check.....	.....	42.49	.....	2,045	.....	.....	.....	.....

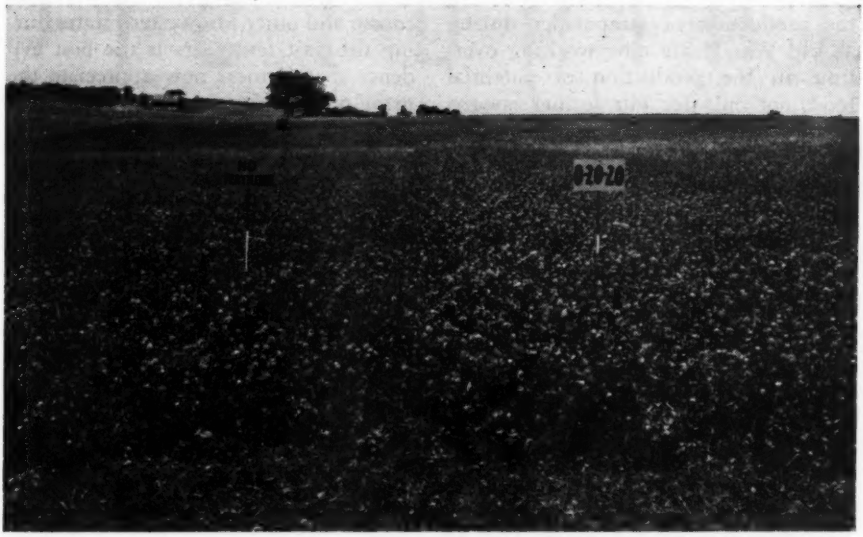


Fig. 3. Liberal application of fertilizer and lime has made medium red clover a dependable crop in Wisconsin. Here on the Leo Wellman farm at Marshfield, the application of 300 lbs. of 0-20-20 per acre the year this clover crop was seeded resulted in a 21-bushel increase in the field of oats and a doubling of the yield of clover hay the year following. Wisconsin farmers are now using over 400,000 tons of commercial fertilizer and over 2 million tons of lime annually.

a profit over and above the cost of the fertilizer. The combination of potash with phosphate has given by far the largest net profit.

Where the residual benefit of the fertilizer to the hay crop has been measured, the yields of this crop have been greatly increased. In fact, we note that the relative response to potash on the hay crop is greater than shown the first year on the grain. (See Table 2.)

Fertilizer applied at the time of seeding gives our new seedings greater vigor and the ability to withstand severe winters.

We are now recommending the use of some nitrogen for small grain as a supplement to phosphate and potash. Opportunity for the use of nitrogen fertilizers in our system of farming in Wisconsin opens up new crop production horizons. The factories built for

TABLE 2.—RESIDUAL CARRY-OVER BENEFIT TO HAY CROP (16 YEARS INCL. 1948). SHOWING TOTAL AVERAGE VALUE OF HAY, GRAIN, AND STRAW, AND PROFIT OVER COST OF FERTILIZER (180 PLOTS).

Treatment	Rate per acre lbs.	Average yield grain bu.	Value of inc. grain & straw[1]	Average yield hay lbs.	Lbs. increase hay[2]	Value of inc. grain straw, hay	Cost of fertilizer	Net profit per acre
0–20–0.....	235	53.6	$11.46	4,748	1,343	$26.23	$3.56	$22.67
3(0–20–10).... (0–20–20)....	235	58.2	16.00	5,506	2,101	39.11	5.18	33.93
Check.....	.....	41.6	.....	3,405	.....	.....	.....	.....

[1] Oats and barley figured at average value of 85¢ per bushel; straw at $5 per ton.
[2] Hay figured at $22 per ton.
[3] The yield data for the 0-20-10 and 0-20-20 plots are averaged together.

the production of gunpowder during World War II are now working overtime in the production of potential food, not only for our former enemy, but for ourselves as well. New factories for the production of synthetic nitrogen are being planned in this country. It is my belief that one of the greatest opportunities for increased production of food and fiber crops lies in the increased use of nitrogen fertilizers.

Table 3 shows the averages for 111 grain plots where a nitrogen fertilizer was used to supplement phosphate and potash.

The question now being asked is "Will Wisconsin soils hold out?" My answer is yes—I am now confident that they will, and for the reason that an entirely new concept of the role of fertilizers in soil conservation and soil fertility maintenance has become a part of the thinking of not only our soils and crops specialists, but of city people and farmers themselves. The unprecedented and spectacular increase in the use of commercial fertilizers in Wisconsin and other Midwestern states during the past few years is the best evidence that farmers now appreciate the great opportunity for crop production increases and profit through the use of fertilizers. Six new fertilizer factories have been built in Wisconsin, with three additional plants recently brought into production just across the Mississippi River on the Minnesota and Iowa side. These factories are making available thousands of tons of commercial fertilizer for use on Wisconsin farms. Tonnage figures show that 404,121 tons of commercial plant foods were purchased by Wisconsin farmers in 1948, and this is nearly 10 times the amount of fertilizer used in Wisconsin in 1939.

Along with this great increase in the use of fertilizers has been the tremendous production and use of agricultural lime. In the past 15 years a total of better than 16 million tons of liming materials have been applied to the acid soils of Wisconsin. Clover again flourishes on our farms. For a period of more than 10 years we have har-

(*Turn to page* 43)

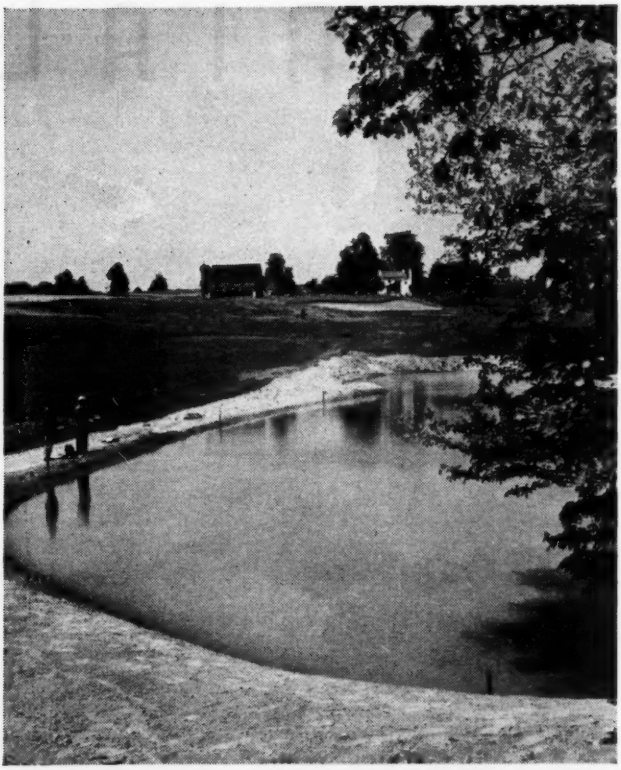
TABLE 3.—AVERAGE YIELDS FOR 111 GRAIN PLOTS—1945, 46, 47, & 48 (TEST PLOTS CARRIED OUT IN 40 WIS. COUNTIES), WHERE A COMPARISON WAS MADE OF 0-20-0 WITH 0-20-10 AND 0-20-20, WITH AND WITHOUT AMMONIUM NITRATE. (AMMONIUM NITRATE APPLIED AS A TOPDRESSING AT AVERAGE RATE OF 95 POUNDS PER ACRE AFTER SEEDING.)

Treatment (Av. for all plots)	Yield per acre grain bu.	Yield per acre straw lbs.	Bushels increase grain	Lbs. increase straw	Value of inc. grain & straw[1]	Cost of fertilizer	Net profit per acre
310# of 0–20–0	53.0	2,299	10.3	404	$9.76	$4.96	$4.80
310# of 0–20–0 + 95# Am. Nitrate	63.4	2,812	20.7	917	19.88	8.06	11.82
310# of the average of 0–20–10 & 0–20–20 plots	57.5	2,515	14.8	620	14.63	7.75	6.88
310# of 0–20–10 & 0–20–20 plots (average) +95# of Am. Nitrate	68.2	3,171	25.5	1,276	24.86	12.85	12.01
No fertilizer	42.7	1,895					

[1] Oats figured at average value of 85¢ per bushel; straw at $5 per ton.

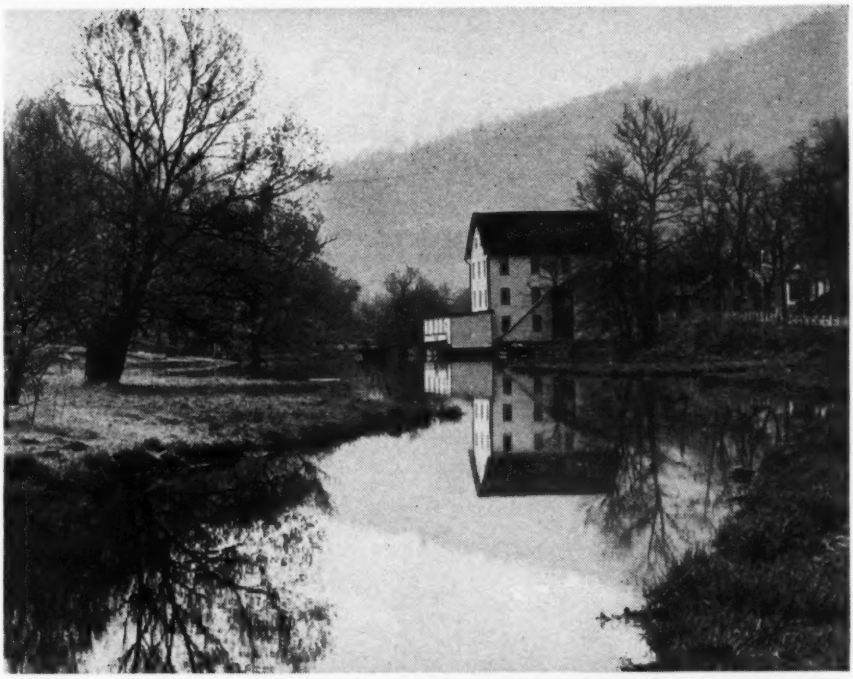
PICTORIAL

Flowers Afield



Left: **Prospecting for fish on the farm.**

Below: **May glamorizes rural landscapes.**



Above: **A good picture—even upside down.**

Right: **An old pump near Mercersburg, Pa.**

Above: Bean picking time.

Below: Selecting quality.

The Editors Talk

Pasture Ideals

May—and the flush of the pastures is on. Even old, worn-out pastures at this season of the year take on a deceptive bloom which belies their worth in good farm management. To those who are following the tremendously increased interest in pastures and the results of research and experimental work in them, the May flush is no deception. They will want to know the stand and nature of the herbage and the ability of the soil to prolong grazing into "cow-days" which will mean real profits. They will determine what might be expected from forage crops on these acres and will undertake steps to obtain it. There now is plenty of evidence to support such procedure. Stemming from the U. S. Department of Agriculture, the State Experiment Stations, and other reliable sources is a wealth of information both already being and awaiting being put into practice.

In a significant statement, R. E. Hodgson of the Bureau of Dairy Industry, U. S. Department of Agriculture, says, "In the past relatively less attention has been given by farmers, even those maintaining livestock as the major enterprise, to improving the yields of pasture and forage crops than to improving the yields of grains and so-called cash crops. Indeed, less research has been done in this direction, as indicated by the relatively slow progress in the development of improved varieties of grasses and legumes and in the development of improved methods of production and utilization. Farmers have used less fertilizer and manure for stimulating production of grassland crops than for grains. Yet these practices will produce as good results, in terms of increased yields, with pastures and meadows as they do with grains. Ample evidence exists to prove the economy of using improved varieties of grasses and legumes, of applying fertilizer and manure, and of using better management practices in the production of grassland crops."

"Grassland crops," he went on to say, "in addition to being soil savers, are also cheap crops to grow. It costs less to produce feed nutrients in pasture and hay than in corn and other grains. . . . Results suggest the advantage of meadow crops, both from the standpoint of the production of feed units and from the standpoint of low costs and low requirements for crop production."

The real importance of this is seen in the fact that in 1946, the latest year for which figures are available, wages of hired farm labor represented 18 per cent of total production expenses of farm operators; and the largest share of farmers' expenses, 22 per cent, went for purchases of feed.

Pasture too often has been relegated to marginal lands or given scant attention by busy, cash-crop-growing farmers. But the day is fast approaching when it will be considered a crop and will be treated as such. In addition to all the pasture work being carried on by State Experiment Stations and Extension Forces, the Soil Conservation Service, and other agencies, the Bureau of Dairy Industry for several years has been investigating at Beltsville, Maryland, methods of pasture improvement. These experiments have dealt with the testing of adapted pasture crops, ways of increasing yields by fertilization, liming and manuring, the renovation of permanent pastures, rotational grazing, and the growing of pastures in rotation with other crops.

Permanent Kentucky bluegrass pastures, as well as orchard grass—bluegrass pastures, have been renovated and the yields are being compared with unrenovated pastures. In the renovation process, the pastures were limed, manured, and then torn up with a heavily weighted disk harrow in the fall. Early the following spring 500 pounds of an 0-14-14 fertilizer per acre were broadcast, and the pastures were double disked, then harrowed again before being reseeded with a mixture of bromegrass, alfalfa, red clover, and Ladino clover. Another 500 pounds of 0-14-14 were applied the next year. The 3-year average of milk yields per acre for the renovated pasture was 21 per cent higher than for the unrenovated pastures which were limed, manured, and fertilized, but not torn up or reseeded.

The moving of pasture up into the full stature of a crop is seen in the Beltsville experiments where pasture is being tried in a 5-year rotation with other crops, as a means of providing extra grazing. The rotation consists of 1 year of corn, 1 year of wheat, and 3 years of a mixture of orchard grass, red clover, and Ladino clover (seeded in the wheat). The wheat and grass-legume stubble is pastured in the fall of the second year, and the grass-legumes are grazed in the third year. In the fourth year two crops of hay are removed and the aftermath is grazed, and in the fifth and final year the pasture is grazed in early spring, then one crop of hay is removed and the field is grazed throughout the remainder of the season. This experiment is still in progress, but from results obtained from the first four years the rotation of crops and pastures averaged 16 per cent more milk per acre than the permanent pasture with which they were compared. The crop rotation pastures produced more feed during the summer, particularly in dry seasons, than the permanent pasture.

Coming into the picture also are the increasing recognition of the importance of grassland farming in soil conservation, the necessity for returning humus and soil fertility to land overcropped during the war and post-war years, the switching in farming systems to keep in line with economic trends, and the new developments in the relationship between soils and human health. All of these will extend the May flush of our pastures. Truly, the growing of two blades of grass where only one grew before is assuming a new meaning to everyone.

Our City Cousins

In this issue we are presenting an article, "The Soil and Human Health," by B. A. Rockwell which is a little aside from our usual presentations of information on crop and soil management, but which we believe will be of interest to our readers. In sending in the story, Mr. Rockwell said, "To the city dwellers and their families, the word conservation as it applies to the soil, together with its ramifications; to wit—erosion, diversion ditches, strip-cropping, rotation, levels of N, P, & K, etc., mean very little, since the action indicated by such words is too far removed from their personal experiences and immediate interests. However, if our city cousins can be confronted with the idea that their health springs from the soil, with sufficient evidence to make such a statement convincing, their personal interests will be excited because food and health are very close to them.

"From such immediate and personal interests, they will eventually begin to realize the importance of soil conservation to their personal well-being. Then if and when legislation is needed to further soil conservation practices, these people from our more thickly populated areas, realizing the important relationship between soil and their health, will through their political influence at the polls help effect such legislation."

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
	Aug.-July	.....	July-June	July-June	Oct.-Sept.	July-June	July-June	July-June	....
Av. Aug. 1909–July 1914	12.4	10.0	69.7	87.6	64.2	88.4	11.87	22.55	....
1924	22.9	19.0	68.6	149.6	106.3	124.7	12.66	33.25	....
1925	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937	8.4	20.4	52.9	82.0	51.8	96.2	8.74	19.51	....
1938	8.6	19.6	55.7	73.0	48.6	56.2	6.78	21.79	....
1939	9.1	15.4	69.7	74.9	56.8	69.1	7.94	21.17	....
1940	9.9	16.0	54.1	85.5	61.8	68.2	7.58	21.73	....
1941	17.0	26.4	80.7	94.0	75.1	94.4	9.67	47.65	....
1942	19.0	36.9	117.0	119.0	91.7	110.0	10.80	45.61	....
1943	19.9	40.5	131.0	204.0	112.0	136.0	14.80	52.10	....
1944	20.7	42.0	149.0	192.0	109.0	141.0	16.40	52.70	....
1945	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946	32.6	38.2	122.0	218.0	156.0	191.0	16.70	71.90	....
1947	31.3	38.0	156.0	215.0	235.0	241.0	17.30	85.40	....
1948									
May	35.27	40.1	196.0	244.0	216.0	222.0	18.30	90.70	....
June	35.22	41.7	187.0	246.0	216.0	211.0	17.90	92.20	....
July	32.99	43.6	166.0	262.0	202.0	203.0	18.20	96.00	....
August	30.41	47.4	158.0	265.0	191.0	196.0	17.80	76.60	....
September	30.94	46.7	153.0	232.0	178.0	197.0	18.00	68.10	....
October	31.07	50.6	142.0	207.0	138.0	198.0	18.40	63.70	....
November	30.52	42.8	144.0	198.0	121.0	204.0	18.40	69.00	....
December	29.63	45.7	154.0	219.0	123.0	205.0	19.10	68.80	....
1949									
January	29.27	42.9	166.0	236.0	125.0	202.0	19.80	65.70	....
February	29.14	29.5	172.0	244.0	112.0	194.0	20.50	53.40	....
March	28.74	31.9	174.0	254.0	118.0	198.0	20.00	51.40	....
April	29.91	24.7	181.0	275.0	122.0	200.0	19.00	50.30	....
Index Numbers (Aug. 1909–July 1914 = 100)									
1924	185	190	98	170	166	141	107	147	143
1925	158	168	245	188	109	163	108	140	143
1926	101	179	189	134	116	138	112	98	139
1927	163	207	146	124	132	135	87	154	127
1928	145	200	76	134	131	113	95	152	154
1929	135	183	189	133	124	117	92	137	137
1930	77	128	131	123	93	76	93	98	129
1931	46	82	66	83	50	44	73	40	115
1932	52	105	55	62	50	43	52	46	102
1933	82	130	118	79	81	84	68	57	91
1934	100	213	64	91	127	96	111	146	95
1935	90	184	85	80	102	94	63	135	119
1936	100	236	164	106	163	116	94	148	104
1937	68	204	76	93	81	109	74	87	110
1938	69	196	80	83	76	64	57	97	88
1939	73	154	100	85	88	78	67	94	91
1940	80	160	78	97	96	77	64	96	111
1941	137	264	116	107	117	107	81	211	129
1942	153	369	168	136	143	124	91	202	163
1943	160	405	188	232	174	154	125	231	245
1944	167	420	214	219	170	160	138	234	212
1945	181	366	205	232	198	170	127	227	224
1946	263	382	175	249	212	209	141	319	204
1947	252	380	224	245	366	273	146	379	249
1948									
May	284	401	281	278	336	251	154	402	262
June	284	417	268	280	336	239	151	409	213
July	266	436	238	298	315	230	153	428	213
August	245	474	227	302	298	222	150	340	172
September	250	467	220	264	277	223	152	302	150
October	251	506	204	236	215	224	155	282	176
November	246	428	207	226	188	231	155	306	186
December	239	457	220	250	192	232	161	305	209
1949									
January	236	429	238	269	195	229	169	291	282
February	235	295	249	279	174	219	173	237	285
March	232	319	250	290	184	224	168	228	263
April	241	247	260	314	190	226	160	223	236

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1924	2.99	2.44	5.87	5.02	3.60	4.25
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948						
May	2.78	1.90	13.77	9.54	12.75	7.89
June	2.78	1.90	14.69	9.11	8.23	8.24
July	2.78	2.07	14.56	9.22	8.80	8.73
August	2.91	2.10	10.91	9.76	8.92	8.98
September	3.00	2.20	10.70	9.87	9.18	9.03
October	3.00	2.20	9.31	9.98	9.41	9.48
November	3.00	2.20	11.00	10.31	10.44	10.68
December	3.00	2.20	11.52	11.65	11.39	11.46
1949						
January	3.15	2.23	10.29	8.68	11.53	11.53
February	3.19	2.27	9.44	12.36	10.78	10.70
March	3.19	2.27	9.27	12.36	9.64	9.71
April	3.19	2.27	9.22	12.36	9.71	9.87
Index Numbers (1910-14 = 100)						
1924	111	86	168	142	107	121
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	12	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948						
May	104	67	393	270	378	224
June	104	67	420	258	244	234
July	104	73	416	261	261	248
August	109	74	312	276	265	255
September	112	77	306	280	272	257
October	112	77	266	283	279	269
November	112	77	314	292	310	303
December	112	77	329	330	338	326
1949						
January	118	78	294	246	342	328
February	119	80	270	350	320	304
March	119	80	265	350	286	276
April	119	80	263	350	288	280

Wholesale Prices of Phosphates and Potash * *

	Superphosphate Baltimore, per unit	Florida land pebble 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1924	.502	2.31	6.60	.582	.860	23.72	.472
1925	.600	2.44	6.16	.584	.860	23.72	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367 [1]
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.498	.706	18.93	.195
1948							
May	.760	4.61	6.60	.375	.669	14.50	.200
June	.760	4.61	6.60	.330	.634 [1]	12.76 [1]	.176
July	.770	4.61	6.60	.353	.676	13.63	.188
August	.770	4.61	6.60	.353	.678	13.63	.188
September	.770	4.61	6.60	.353	.678	13.63	.188
October	.763	4.61	6.60	.375	.720	14.50	.200
November	.770	4.61	6.60	.375	.720	14.50	.200
December	.770	4.61	6.60	.375	.720	14.50	.200
1949							
January	.770	4.61	6.60	.375	.720	14.50	.200
February	.770	4.61	6.60	.375	.720	14.50	.200
March	.770	3.85	7.06	.375	.720	14.50	.200
April	.770	3.85	7.06	.375	.720	14.50	.200
Index Numbers (1910-14 = 100)							
1924	94	64	135	82	90	98	72
1925	110	68	126	82	90	98	74
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948							
May	142	128	135	68	70	60	83
June	142	128	135	62	67	53	80
July	144	128	135	65	71	56	82
August	144	128	135	65	71	56	82
September	144	128	135	65	71	56	82
October	142	128	135	68	76	60	83
November	144	128	135	68	76	60	83
December	144	128	135	68	76	60	83
1949							
January	144	128	135	68	76	60	83
February	144	128	135	68	76	60	83
March	144	107	145	68	76	60	83
April	144	107	145	68	76	60	83

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1924	143	152	143	103	97	125	94	79
1925	156	156	151	112	100	131	109	80
1926	146	155	146	119	94	135	112	86
1927	142	153	139	116	89	150	100	94
1928	151	155	141	121	87	177	108	97
1929	149	154	139	114	79	146	114	97
1930	128	146	126	105	72	131	101	99
1931	90	126	107	83	62	83	90	99
1932	68	108	95	71	46	48	85	99
1933	72	108	96	70	45	71	81	95
1934	90	122	109	72	47	90	91	72
1935	109	125	117	70	45	97	92	63
1936	114	124	118	73	47	107	89	69
1937	122	131	126	81	50	129	95	75
1938	97	123	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	124	131	127	86	56	130	102	77
1942	159	152	144	93	57	161	112	77
1943	192	167	151	94	57	160	117	77
1944	195	176	152	96	57	174	120	76
1945	202	180	154	97	57	175	121	76
1946	233	202	177	107	62	240	125	75
1947	278	246	222	130	74	362	139	72
1948								
May	289	265	239	137	85	370	142	71
June	295	266	241	128	85	309	142	65
July	301	266	247	231	88	317	144	68
August	293	266	247	129	91	285	144	68
September	290	265	247	131	94	287	144	68
October	277	263	243	130	94	277	142	72
November	271	262	239	134	94	311	144	72
December	268	262	237	137	94	336	144	72
1949								
January	268	260	233	136	97	313	144	72
February	258	257	231	136	99	309	144	72
March	261	258	231	134	99	290	144	72
April	260	258	229	134	99	291	144	72

* U. S. D. A. figures. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. Since 1937, the maximum discount has been 12%. Applied to muriate of potash, a price slightly above $.471 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Commercial Fertilizers Report for 1948," Conn. Agr. Exp. Sta., New Haven, Conn., Bul. 525, Dec. 1948, H. J. Fisher.

"Vegetable Fertilizer Recommendations for Delaware," Ext. Serv., Univ. of Del., Newark, Del., 1949, R. F. Stevens.

"State Laboratory Fertilizer, Feed, Seed, Lime and Ice Cream Report, July-December—1948," State Board of Agr., Dover, Del., Vol. 38, No. 4.

"Nitrogen-Fertilizers for Grain Crops," Dept. of Agron., Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Mimeo Leaflet No. 111, Feb. 1948, G. O. Baker.

"The Use of Gypsum and Sulfur Fertilizers on Sulfur Deficient Soils," Dept. of Agron., Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Mimeo Leaflet No. 113, March 1948, G. O. Baker.

"Analyses of Official Fertilizer Samples," Feed and Fertilizer Dept., Ky. Agr. Exp. Sta., Lexington, Ky., Regulatory Bul. 69, Dec. 1948, Semi-annual Report, Jan.-June 1948.

"Official Report, Maryland Inspection and Regulatory Service—Feed, Fertilizer and Lime Issue," College Park, Md., Issue No. 208, Jan. 1949.

"Fertilizer Recommendations for Mississippi, 1949," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 145, Feb. 1949, F. J. Welch.

"The Tonnage Summary of Mixed Fertilizers, Fertilizer Materials, and Limes Reported as Being Sold in New Jersey During 1948," State Agr. Exp. Sta., New Brunswick, N. J., Apr. 11, 1949, S. B. Randle.

"Fertilizer Recommendations for Texas—1948-1949," Ext. Serv., Texas A & M, College Station, Texas, B-165, 1948, M. K. Thornton.

"Fertilizers for Eastern Washington," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Bul. 385, Feb. 1949.

Soils

"Soil Management and Fertilizer Use," Statistics and Publications Branch, Ontario Dept. of Agr., Toronto, Ont., Can., Bul. 463, Jan. 1949.

"Chemical Studies on Soils from Florida Citrus Groves," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 448 (Bul. 340 Rev.), Sept. 1948, T. W. Young.

"Vermont Soils Need 400,000 Tons Lime Annually," Ext. Serv., Univ. of Vt., Burlington, Vt., Unno. Pamphlet, Feb. 1949.

"Conservation Practices for Tobacco Lands of the Flue-cured and Maryland Belts," U.S.D.A., Washington, D. C., Misc. Publ. 656, Nov. 1948, T. L. Copley, C. S. Britt, and W. B. Posey.

"Irrigation Agriculture in the West," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Misc. Publ. 670, Nov. 1948.

"Investigation in Erosion Control and the Reclamation of Eroded Land at the Missouri Valley Loess Conservation Experiment Station, Clarinda, Iowa, 1931-42," Soil Conservation Service, US.D.A., Washington, D. C., Tech. Bul. 959, Oct. 1948, G. M. Browning, R. A. Norton, A. G. McCall, and F. G. Bell.

Crops

"Controlling Diseases of Tobacco," Conn. Agr. Exp. Sta., New Haven, Conn., Bull. 527, Feb. 1949, P. J. Anderson.

"Your Freedom Garden," Ext. Serv., College of Agr., Univ. of Conn., Storrs, Conn., Ext. Folder No. 21, March 1948, W. E. Chappell.

"Grasses for Lawns, Parks and Athletic Fields," Ext. Serv., College of Agr., Univ. of Conn., Storrs, Conn., Ext. Folder No. 22, March 1948, B. A. Brown.

"Carpet Grass and Legume Pastures in Florida—Their Growth, Composition and Contribution to Beef Production," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 453, Dec. 1948, R. E. Blaser, R. S. Glasscock, G. B. Killinger, and W. E. Stokes.

"Twenty-eighth Annual Report, 1947-1948," Ga. Coastal Plain Exp. Sta., Univ. System of Ga., Tifton, Ga., Bul. 46, July 1948.

"Introducing Pandora Cotton for the Georgia Coastal Plain," Ga. Coastal Plain Exp. Sta., Univ. System of Ga., Tifton, Ga., Cir. No. 12, Dec. 1948, J. H. Turner, Jr.

"Cotton Variety Tests in Georgia, 1946-48," Ga. Exp. Sta., Univ. System of Ga., Experi-

ment, Ga., Cir. 159, March 1949, B. S. Hawkins, T. E. Steele, W. W. Ballard, and S. V. Stacy.

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"Legumes and Grasses for Silage—A Report of Experiments," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 529, Nov. 1948, W. B. Nevens, K. E. Harshbarger, and K. A. Kendall.

"1948 Illinois Tests of Corn Hybrids in Widest Use," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 531, Feb. 1949, J. W. Pendleton, G. H. Dungan, J. H. Bigger, A. L. Lang, Benjamin Koehler, R. W. Jugenheimer, and G. E. McKibben.

"Corn Borer Control in Field Corn," Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 637, Feb. 1949.

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"Lespedeza Sericea," Ext. Serv., Miss. State College, State College, Miss., Ext. Agron. Folder No. 6, March 1949, W. R. Thompson.

"Kudzu," Ext. Serv., Miss. State College, State College, Miss., Ext. Agron. Folder No. 7, March 1949, W. R. Thompson.

"Johnson Grass," Ext. Serv., Miss. State College, State College, Miss., Ext. Agron. Folder No. 8, March 1949, W. R. Thompson.

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"The South Will Come Into Its Own When Pastures are Green All Year," Ext. Serv., Miss. State College, State College, Miss., Ext. Agron. L. No. 7, March 1949, W. R. Thompson.

"Grow More Corn," Ext. Serv., Miss. State College, State College, Miss., Ext. Leaflet 82 (Rev.), Feb. 1949, W. R. Thompson.

"Tomato Cultural Studies," Agr. Exp. Sta., Miss. State College, State College, Miss., Serv. Sheet 410, May 1948, L. R. Farish.

"Producing 100 Bushels of Corn per Acre," Agr. Education Dept., State College, Miss., Veterans Farm Training Publ. No. 7, Feb. 1949.

"Farm and Home Builders," Agr. Ext. Serv., Univ. of Mo., Columbia, Mo., Cir. 569, Feb. 1949, A. R. 1948.

"The Management of Farm Woodlands in New Hampshire," Agr. Ext. Serv., Univ. of N. H., Durham, N. H., Ext. Bul. 88, June 1948, K. E. Barraclough.

"Tips on Growing Spring Oats," Ext. Serv., College of Agr., Rutgers Univ., New Brunswick, N. J., Leaflet 14, March 1948, C. S. Garrison and J. E. Baylor.

"A Guide to Forest Tree Planting in New Jersey," Ext. Serv., College of Agr., Rutgers Univ., New Brunswick, N. J., Leaflet 19, May 1948, A. N. Lentz.

"Research and Farming," Agr. Exp. Sta., Raleigh, N. C., Vol. VII, No. 3, Jan. 1949.

"Nineteenth Annual Report of the New Mexico Feed and Fertilizer Control Office, Year Ending December 31, 1948, Commercial Fertilizers," N. M. Feed and Fertilizer Control Office, State College, N. M., R. W. Ludwick and L. T. Elliott.

"Oklahoma Corn Performance Tests Summary: 1946, 1947 and 1948," Agr. Exp. Sta., Okla. A & M, Stillwater, Okla., Bul. B-327, Feb. 1949, J. S. Brooks, Roy Chessmore, and Hartwill Pass.

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"A Study of Red Cedar Plantations in North Central Oklahoma," Agr. Exp. Sta., Okla. A & M, Stillwater, Okla., Tech. Bul. T-34, March 1949, Michel Afanasiev.

"Better Gardens for Better Health—An Oklahoma Garden Planning Guide," Okla. A & M, Stillwater, Okla., Cir. 487, E. L. Whitehead.

"Performance Tests, 1948," Agr. Exp. Sta., Okla. A & M, Stillwater, Okla., Mimeo. Cir. M-177, Dec. 1948, J. S. Brooks, Roy Chessmore, and Hartwill Pass.

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"A New Method for Ripening Dates," Agr. Exp. Sta., Texas A & M, College Station, Texas, P. R. 1139, Nov. 27, 1948, J. S. Morris, and G. H. Godfrey.

"Summary of the 1948 Texas Corn Performance Tests," Depts. of Agron. and Plant Physiology and Pathology, Agr. Exp. Sta., Texas A & M, College Station, Texas, P. R. 1140, Nov. 29, 1948.

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"Ten Years of Dairy Farming in Vermont," Agr. Exp. Sta., Univ. of Vt., Burlington, Vt., Bul. 548, Jan. 1949, V. R. Houghaboom.

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"Vegetable Garden Suggestions for Virginia Farmers," Agr. Ext. Serv., Va. Polytechnic Inst., Blacksburg, Va., Cir. 475, Nov. 1948, F. S. Andrews, L. C. Beamer, and F. H. Scott.

"What's New in Farm Science," Agr. Exp. Station, Univ. of Wis., Madison, Wis., Bul. 480, Dec. 1948, A. R. of the Director, Part Two.

"Safeguarding New Seedings," Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 300, (Rev. March 1948), Apr. 1940, H. L. Ahlgren and L. F. Graber.

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"Production of Drug and Condiment Plants," U.S.D.A., Washington, D. C., Farmers' Bul. 1999, Dec. 1948, A. F. Sievers.

"Producing Cigar Tobacco in Pennsylvania," U.S.D.A., Washington, D. C., Farmers' Bul. 2001, Dec. 1948, O. E. Street.

"Factors Affecting the Nutritive Value of Foods," U.S.D.A., Washington, D. C., Misc. Publ. 664, Dec. 1948.

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Economics

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"Seasons for California Crops and Livestock," Univ. of Calif., Berkeley, Calif., Rev. April 1948, G. B. Alcorn.

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"Law for the Illinois Farmer," Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 632, Nov. 1948, H. W. Hannah.

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"Farm Organization and Production Requirements in Selected Irrigated Areas," Agr. Exp. Sta., Mont. State College, Bozeman, Mont., Bul. 453, Oct. 1948, R. E. Huffman and D. C. Myrick.

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"A Study of Farms in Oklahoma by Size and Economic Class," Agr. Exp. Sta., Okla. A & M College, Stillwater, Okla., Exp. Sta. Bul. B-330, Feb. 1949, R. T. McMillan.

"1949 Farm Production Prospects in Oklahoma," Agr. Exp. Station, Okla. A & M, Stillwater, Okla., Mimeo Cir. M-175, Oct. 1948.

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High Plains—1947 Season," Agr. Exp. Sta., College Station, Texas, P. R. 1134, Oct. 1, 1948, M. M. Williamson and R. H. Rogers.

"Keeping up on the Farm Outlook," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. 132, March 31, 1949, Karl Hobson.

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"Commodity Futures Statistics, July 1947-June 1948," Commodity Exchange Authority, U.S.D.A., Washington, D. C., CS-34, Nov. 1948.

"The Balance Sheet of Agriculture, 1948," Bu. of Agr. Econ., U.S.D.A., Washington, D. C., Misc. Publ. 672, 1948, N. J. Wall, A. S. Tostlebe, F. L. Garlock, R. J. Burroughs, H. C. Larsen, H. T. Lingard, L. R. Hudson, and S. L. Yarnall.

"Potatoes for Livestock Feed," Production and Marketing Admin., U.S.D.A., Washington, D. C., Misc. Publ. 676, Oct. 1948, C. R. Allender.

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Complete Fertilizers for Rice

THE use of fertilizers on rice in Louisiana has increased markedly since 1942 and the farmers' interest in different fertilizers and the methods of their application has increased even more. Heavy weed infestations and the difficulty of controlling weeds in a rice field, especially one that has received a liberal application of nitrogenous fertilizer at or before planting, have limited the use of fertilizers and the benefits from them. Experience and experiments have shown that when an amount of nitrogen greater than 16 pounds per acre is applied with and at the same level as the seed the increase in weed growth tends to depress the increase in rice due to fertilizer. Since in its most efficient use, one pound of nitrogen is required for the production of one bushel of rice, methods conducive to the effective use of more nitrogen had to be developed.

Two methods for the addition of complete fertilizers to rice have been successful. One involving the application of 300 pounds per acre of 0-16-0, 3-9-6, or 3-12-12 with or under the seed at planting, followed by applications of 24 to 32 pounds per acre of nitrogen as a topdressing before the booting stage, has given good results. A modification of this scheme for water-planted rice where the phosphate or complete fertilizer is applied before planting and the extra nitrogen as a topdressing shows particular promise.

The other method, which has been more successful, involves drilling the fertilizer two inches below the seed at planting. Fertilizer experiments with this procedure have been conducted throughout the rice area. The placement of the fertilizer below the seed has increased the yield of rice 8.5 bushels per acre over the old method of drilling the fertilizer directly with the seed. The increase in the efficiency of the fertilizer has made possible better evaluation of the adaptation of various grades to the different soil conditions. The best adapted mixtures have been 6-6-6, 9-6-9, 6-9-9, 3-9-6, and 6-9-0 applied at the rate of 400 pounds per acre. The average increase due to fertilizers was 20.9 bushels per acre.

Minor elements were applied in 1948, but no significant increases were obtained.—R. K. WALKER AND M. B. STURGIS, *Louisiana Agricultural Experiment Station, Baton Rouge, Louisiana.*

Five Years of 500-bushel Clubs

(*From page* 21)

a complete fertilizer. This provides a fair amount of organic matter to be plowed or disked under the following spring. It serves also in retarding soil erosion. Numbers of farmers have reported less scab infestation with this practice.

More fertilizer per acre is being employed in reaching for these higher yields. Where 500 pounds of a 4-8-10 were thought to be adequate a few years ago, growers are now using 1,000 to 1,500 pounds. The top winner in 1947 used 3,200 pounds of fertilizer.

But farmers of Ontario were not content with 500-bushel Potato Clubs alone. For instance, large quantities of cereals were required, and Provincial yields were on the decrease. Statistics stated the 10-year average yield for oats in Ontario was 33.8 bushels per acre. Authorities claimed very excellent yields could be obtained from corn for grain. There was a growing export demand for turnips, but some farmers were not getting satisfactory yields. Peas for protein were being successfully grown by some, yet results were disappointing in other cases. At one time, fall wheat was an important cash crop, but interest had dwindled, perhaps largely because of low yields.

These factors led to objectives, and action. As in 500-bushel Potato Clubs, members of Crop Improvement Associations accepted the challenge and took the lead. Each recent year has seen an increase in organization of 100-bushel Oat Clubs, 50-bushel Barley Clubs, 1,000-bushel Turnip Clubs, 50-bushel Wheat Clubs, 30-bushel Pea Clubs, 100-bushel Corn Clubs, and recently pasture competitions have been undertaken for the first time.

The far-reaching results of these objective competitions are beyond all ex-

Fig. 3. A Potato Growers' banquet in Middlesex County.

pectations of those who originally conceived the idea. "They builded better than they knew," might well be apt.

Set objectives per acre have become a by-word in many communities. Experience has taught many that high yields of a quality product pay dividends by reducing the production cost per unit. With urgent demands for foodstuffs in general, and cereals in particular, maximum production per acre therefore serves a twofold purpose in providing food for the needy and larger profits for the grower.

Mississippi Can Grow . . . Corn

(*From page* 14)

practically identical."—Bull. 191, Tenn. Exp. Sta.

"It has generally been thought that the cultivation of corn is necessary in order to form a mulch as a means of lessening the loss of soil moisture through evaporation. This assumption leads to the belief that the drier the year, the greater the need for cultivation. There seems to be no evidence, however, to justify the conclusion that a soil mulch conserves moisture unless the water table is either permanently or temporarily near the ground surface. A dry crust is probably just as effective in checking the movement of water vapor from the deeper layers of moist soil to the open air as is a dry, granular layer serving as a mulch. The plowed layer is far more valuable as a feeding ground for the corn roots than it is as a mulch to slow down the loss of moisture through evaporation."—Cir. 597—Ext. Service, Univ. of Illinois.

Preliminary studies on use of 2,4-D in corn production indicate the folly of constantly stirring the ground. No doubt we have progressed far enough with 2,4-D on corn to justify limited demonstrations on a much wider scale in our production program. This seems to have unlimited possibilities.

It is essential, insofar as practicable and if consistent high yields are to be expected, to select a soil of good structure or tilth. This type soil is usually one in a long-term, deep-rooted legume rotation or sod, or one that otherwise has been treated to keep the organic matter well supplied. Heavy clays, loamy sands, and sands are usually considered unsafe. To play safe, a soil analysis test should be made. The subsoil as well as the topsoil should have a desirable pH. No hardpan or restriction should exist.

A healthy soil is much more likely to resist the various fungus and bacterial diseases which sometimes are prevalent causing considerable loss through poor photosynthesis, lodging, etc. If there is doubt as to a soil's needs to provide resistance to disease, (1) try stable manure, (2) rotate with a deep-rooted legume. The following statement indicating that consideration be given to structure-tilth conditions in making fertilizer recommendations is no doubt of extreme importance:

"The soil chemists should also adjust the interpretation of the commonly used soil tests for making recommendations for the use of fertilizers to include the soil structure-tilth conditions under which the crops will be grown."—G. N. Hoffer.

The proverbial "Mouse Trap" has never been more fully exemplified than in the case of R. B. Caldwell, Sr., in taking the lead in the production of corn in his community and in Mississippi. During the past three years several thousand students, farmers, vet-

eran trainees, agricultural leaders, scientists, and editors, from the majority of counties in Mississippi and from adjoining states have visited his farm to study his method of producing corn. Many hundreds have gone back home and followed his plan. In the Caledonia community alone there has been a remarkable spread in adopting the plan for higher yields of corn. During 1948, approximately 200 farmers followed the plan. Of 139 farmers with fields covering 304 acres which were checked closely for yields, the average production was 84.2 bushels per acre. Thirty-five farmers have exceeded the 100-bushel objective.

When agricultural history is written in Mississippi it is doubtful if there will be found a more outstanding production accomplishment anywhere than that of producing corn in the Caledonia community. This project is the consummation of organized instruction, through a cooperative undertaking begun in 1945-46, under the leadership of S.C.S. Technicians assigned to Lowndes County Soil Conservation District and the Vocational Agriculture Teacher of the Caledonia Consolidated High School. Veteran Instructors made distinct contributions during 1947 and 1948.

What is Happening to Wisconsin Soils?

(*From page* 26)

vested an average of over a million acres of alfalfa.

The average yields of grain and corn have been increased a good 30% in the past 10 years. Part of this increase is, of course, due to the more extensive planting of our higher yielding strains of hybrid corn and the disease-resisting varieties of oats and other grains. But I am sure that the increased use of lime and fertilizers has played an important role in these higher average yields.

Our educational efforts have been fruitful. I am confident that even though our job in Wisconsin is far from finished, with the support and assistance that have been given through the Soil Conservation Service and the AAA (now the Production and Marketing Association), we can look forward to new achievements in the field of crop production, soil fertility maintenance, and conservation.

Here are 12 suggestions which, if followed, will result in substantial increases in crop production and as well fit into a program of soil fertility maintenance and conservation:

1. Conserve all animal manures. Use sufficient litter and absorbents so as to save all the liquid portion and get it back onto the land. To reduce losses of ammonia from fermented manure, reinforce with superphosphate at the rate of one pound per cow per day in gutters of stable or in loose or open-run barns.

2. Have your soils tested to determine lime and fertilizer requirements.

3. Apply phosphate or phosphate-potash fertilizers (according to soil test) at the time of seeding down for spring grain or legume seedings. Apply such fertilizers as 0-20-20 or 0-20-10 at rates from 300 to 400 lbs. per acre. Where straw growth is apt to be short, supplement with ammonium nitrate or other nitrogen fertilizer and apply as a topdressing at rates from 75 to 100 lbs. per acre. On fields where there

is no danger of lodging and that are only moderately short on nitrogen, apply from 300 to 400 lbs. of mixtures containing some nitrogen, such as 3-12-12, 4-12-8, or 3-18-9.

4. For fall-seeded grain (wheat or rye) apply 250 to 300 lbs. of 3-12-12, 4-12-8, or 3-18-9 per acre. On thinner fields where there is no danger of lodging, topdress winter wheat or rye in the spring with ammonium nitrate or other nitrogen fertilizers at rates of from 75 to 150 lbs. per acre. (If seedings of legumes or grasses are to be made, omit treatment with nitrogen fertilizer).

5. For corn, as a supplement to applications of stable manure, apply from 125 to 200 lbs. of starter fertilizer (3-12-12, 4-12-8, or 3-18-9) per acre with attachment on planter.

6. For corn on low fertility fields and where no manure is available, apply from 600 to 800 lbs. of 8-8-8 or similar fertilizer per acre. These heavy rate applications of high-nitrogen fertilizer should be drilled in deep ahead of planting or placed on plow-sole with attachment on plow, or plowed under.

7. Renovate old June grass pastures (apply lime and fertilizers according to soil test) and seed them to deep-rooted legumes and bromegrass or other recommended pasture mixtures.

8. Topdress timothy or other grassland hay or pasture meadows every spring with ammonium nitrate or other nitrogen fertilizers (apply ammonium nitrate at from 150 to 200 lbs. per acre, or ammonium sulphate, cyanamid, or nitrate of soda at from 200 to 275 lbs. per acre). Supplement these nitrogen fertilizers with from 200 to 250 lbs. of 0-20-20 or 0-20-10 where fields have been in sod for many years and where little or no manure or commercial fertilizer has ever been applied, and repeat treatments with 0-20-20 or 0-20-10 every three or four years.

9. On sloping fields where erosion is a serious factor, seed down to long-lasting stands of alfalfa and bromegrass and include some ladino clover where the fields are to be used for pasture.

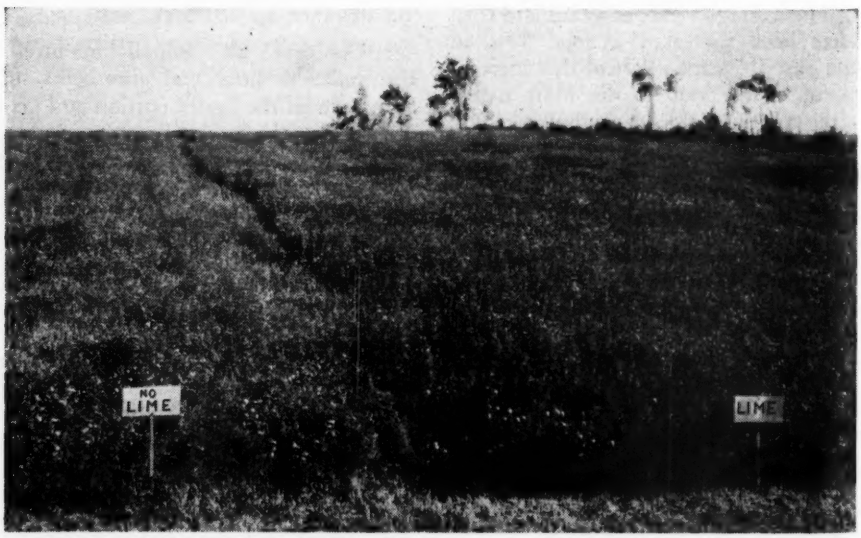

Fig. 4. An important factor in "making sure" with alfalfa has been the 16 million tons of lime applied to Wisconsin's acid soils during the past 15 years. Wisconsin farmers are now growing more than a million acres of this "de luxe member" of the legume family. On the Charles Peterson farm at Darlington we see what happened when no lime was applied. The entire field was given a light dressing with "phosphated manure" at the time of seeding down.

10. Work erodible fields on contour and follow all recommended practices of soil erosion control.

11. Increase acreage of deep-rooted, long-lasting, drought-resisting alfalfa. Cut down acreage of corn on erodible land and use more alfalfa and brome or other grass and legume mixtures for silage.

12. Build back organic matter reserves into your soil by plowing under more crop residues and green manure. Plow under a second crop of hay occasionally.

Thousands of farmers are carrying out many of these recommended practices and their farms reflect the improvement that follows in the wake of these principles of good farming. Their prosperity is reflected in modernized and well-equipped farm homes that make for convenience, comfort, and happiness. Larger farm income makes possible greater opportunity for the boys and girls growing up in these homes. And it all adds up to more abundant living and a more permanent and lasting type of agriculture.

The Soil and Human Health

(*From page* 18)

attempt to come up with the answer of "Why Health?" A brief summary of the observations and reports of Schomberg, Skrine, Durand, and Dr. McCarrison shapes up as follows: The most conspicuous feature of the Hunza diet is the large amount of native fruit they eat, fresh in summer and dried at other times. There was at the time these observations were made such large quantities of fruit produced in Hunza that even the animals took the fruit diet. Other articles of diet were whole wheat bread, pulses and vegetables, barley and millet, fermented milk (no sweet milk), buttermilk, butter, curd cheese, and on rare occasion some fowl and meat. There also was wine, in moderation, made from fruit juices. Fundamentally then, their diet was not much different from that of other people and yet after a more complete study of their eating habits, two differences appeared.

In the first place, the Hunzas ate no sugars other than those which were contained naturally in the fruits and vegetables. Could this be the reason why a decayed tooth was a great rarity? Secondly, they ate more wholesomely than humans in the so-called supercivilized centers, if civilized is the proper word. That is, they consumed every portion of fruits, vegetables, fowls, and animals that could be chewed, swallowed, and digested.

Is there any avenue of reasoning or scientific explanation that would justify such an eating practice? The answer is yes. For example, the skin of a healthy fruit, vegetable, or chicken contains barriers which fight against skin infections. Furthermore, the essential elements and factors of growth and life are transferred to the individual by food. If humans would eat skins from potatoes, apples, or carrots, etc., or the skin of healthy fowls, then we could expect a certain amount of transfer of infection-fighting barriers to the human skin. It is generally conceded that at all times, there lurks in the mouth, nose, throat, and lungs, disease germs such as cold, pneumonia, tuberculosis, and others. But if the skin membranes in this part of the anatomy are healthy due to the presence of barriers, the disease cannot develop. Otherwise, we would be sick most of the time.

Of necessity, Dr. Robert McCarrison must re-enter this research drama, "Why Health?" Previously in this story was given a brief summary of his experiences and observations during his first seven-year association with the Hunzas. Incidentally, McCarrison observed two other groups of people, namely the Pathans and the Sikhs, who rivaled but did not quite equal the Hunzas in physical excellence. He observed, however, that the Pathans and Sikhs lived in non-fruit-producing areas. It will be important to keep this fact (non-fruit areas) in mind in order to appreciate McCarrison's sound thinking which steered his excellent scientific approach into the question, "Why Health?"

Dr. McCarrison had shown through application and action during his medical career which began in 1900 that he had the inborn mind of a research worker. Consequently, he was appointed Director of Nutritional Research for India, where he returned in 1927 and set up his laboratory at Coonoor.

During his absence from Hunza, he had never forgotten the splendid physique of the Hunzas and had long pondered—why? Now came the opportunity for which he had been waiting, to investigate the Why of the Health of the Hunzas, the Pathans, and the Sikhs. He decided upon a wholesome research procedure to determine the why of health which was a direct reversal to the fragmented research of the past to learn the direct or immediate causes of diseases.

After having observed the vibrant health of the Hunzas in contrast to the physical degeneracy and ill health in many other global localities, he wondered if by using white rats as the guinea pigs he could duplicate through food in rat colonies the two extremes of health and disease which he had observed in humans. He began to experimentally feed two colonies of white rats, all conditions being identical except the geographical origin of the two diets offered—one being food produced in the Hunza, Pathan, and Sikhs regions. Since the Pathans and Sikhs lived in non-fruit producing areas, fruit was excluded from the diet to make the experiment more comprehensive. The other diet was from areas of India where people were poor and undernourished and, of course, quite physically degenerated and sickly.

In briefing the feeding test results of the Hunza diet, we shall quote Dr. McCarrison, "During the past two and a quarter years, there has been no case of illness in this universe of albino rats, with the exception of an occasional tapeworm cyst."

The results of feeding the other rats, including 2,243 individuals, really opened the lid of Pandora's box, since diseases and miseries of many kinds flew forth. With the exception of the brain, which was not examined, just about every other organ became diseased. Freeing it of technical dressing, this group of rats fed faulty food got diseases of the respiratory system, adenoids, pneumonia, bronchitis, pleurisy, infections of the nose, ears, and eyes, ulcer and cancer of the stomach, inflammation of the small and large gut, constipation and diarrhea, disease of the urinary passage, such as Brights disease, stone abscesses, inflammation of the bladder, inflammation of womb and ovaries, death of the foetus, premature birth, hemorrhage, disease of the testicles, inflammation of the skin, loss of hair, ulcers, abscesses, gangrene of the feet and tail, anemias of the blood, enlarged lymphatic glands, inflammation of outer lining of the heart, degeneration of nervous tissues, diseased bones and teeth, dropsy, scurvy, feeble growth, lassitude, and ill-temper.

To digress a moment from McCarrison's Coonoor rat experiments, the following should have passing interest: The difficulty with early polar expeditions was the inability to carry sufficient food. A number of such expeditions perished for this reason. It was not until Stefansson, the famous polar explorer, through the aid of one of his

sled dogs, made a remarkable discovery which overcame the lack of food hazard while exploring the polar regions. The dog barked at something which appeared like nothing. Investigation revealed a hole in the ice. Patient watching by Stefansson was rewarded by a seal nose appearing in the hole in the ice, kept open to get air. Thereafter, Stefansson and his men watched these holes and when a seal came there for air, he was speared and then chopped out of the ice. The writer heard Stefansson say that he and his men lived for the greater portion of two years on seal meat, and no disease from dietary deficiencies resulted.

How can we explain this amazing fact? Well, it must be remembered that about 20 times more plant nutrient essentials, through human neglect, wash into the oceans each year than are used by plants. This abundance of essential nutrients supports the lower marine forms of life which support the little fish, which support the larger fish. Consequently, seal meat thus supported was not deficient in any essential and, therefore, was nutritionally a perfect food. Such a diet would indeed be monotonous, but it proves that health can be maintained from one food if said food contains all the essentials. Eliminating one item of food in the diet, as McCarrison did in the case of fruit desirable as fruit may be, is not important provided other items of food, either few or many, contain in the aggregate all the essential food factors. When in doubt, eat salt water fish since it is probably one of our most complete foods. Generally speaking, in choosing other foods it is wise to select a variety, since a variety will be products of a wide and varied geographical area.

The Soil

After McCarrison had perfected health and also caused disease in rats in accordance with diets he gave them, there was just one more factor left to be explored for the basic reason for health, and that was the soil from which the diet of the very healthy rats originated. His investigations revealed that the Hunza people were excellent farmers, tended their crops diligently, and saw to it that no soil was lost from erosion. Previous to and at the time of his investigation, they were a self-sufficient people, consumed all the food they produced, and sold nothing. Furthermore, nothing was wasted or destroyed and everything with any plant-food value was returned to the soil. Even all human excrement was processed for this purpose. So, the nutritional cycle was complete without soil nutritional losses.

The only conclusion to be arrived at by Dr. McCarrison as the results of his extensive research is as follows: The soil, which maintained these three different peoples and more especially the Hunzas, was complete. That is, it contained all essential elements and factors to maintain perfect life. From the soil, the health-giving factors were transferred to the plants and to animals and finally to the humans who ate of these plants and animals. The results were a people of unexcelled health and physical fitness. The answer to Dr. McCarrison's question of "Why the Hunza Health" was the Hunza soil.

From this revealing bit of research, the original statement that baby thrives on cow's milk in proportion to the soil's ability to transfer to the forage and grain growth the health, which in turn is transferred to baby through the milk, seems quite true.

Quoting Frank A. Gilbert, Ph.D., a renowned scientist in the field of nutrition, "It is not possible to separate the problems of increasing the productivity of our farms, raising the biological value of our crops, keeping our domestic animals in good condition, and thus maintaining the health of our people."

Indeed the problem is large as it applies to the soil from which all new wealth is created. Wealth plus health, which adds up to happiness, stem right back to the soil. But the general public

indifference caused by ignorance to soil conservation is alarming. Some group or groups of society should energetically spearhead a general educational program to the point where our citizenry will fully realize that "The Soil Is Our Life" and that soil is the answer to the question, "Why Health?"

If and when, through a very general educational campaign, our people could learn how rapidly we are losing our topsoil in this country, together with its implications, they might be aroused to a point of willingness to finance a more complete soil-conserving and rebuilding program. By so doing, such campaigns as are now being conducted for tuberculosis, cancer, heart, and the like might be unnecessary.

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Addition of Micronutrients to Fertilizer

(*From page* 8)

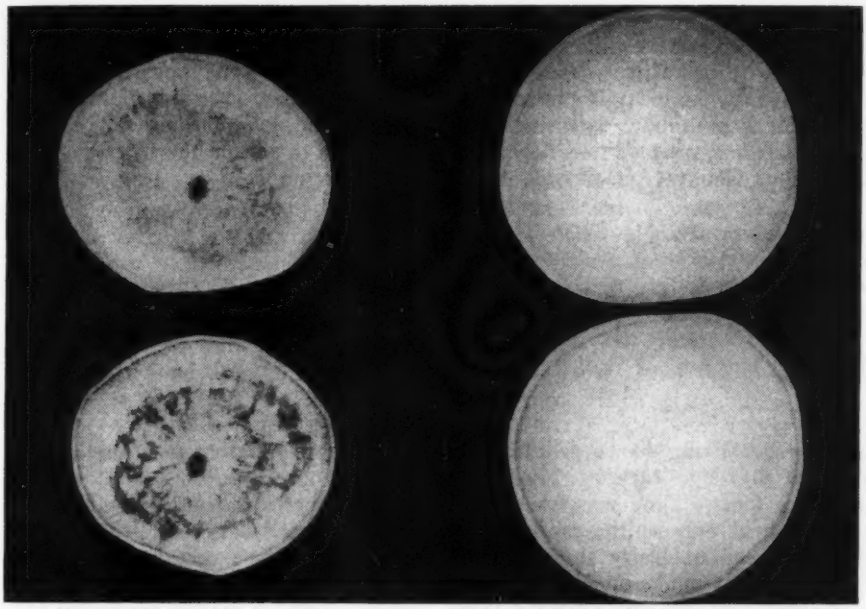
rate where borax is needed. It is no particular problem to make such a grade available, but warning tags must be attached to each bag to keep such fertilizer from being used for boron-sensitive crops. New York recommends 10 pounds of borax per acre for cauliflower for Long Island and the Albany and Buffalo areas, and 25 pounds in the Catskill area. Servicing these recommendations is no problem, but the amounts called for are greater than are likely to be added in a "shot-gun" mix.

For the production of onions on the muck soils in Orange County, New York, 300 pounds of copper sulphate per acre are recommended to be used as often as needed. Since this is only once in every 3, 4, or 5 years, farmers usually apply it separately. Again, it is a need that is not met by the addition of a pound or two of copper sulphate to each ton, although it is possible that under certain unusual conditions a pound or two per ton might be of some value.

On the alkaline muck soils of western New York, 200 pounds of manganese sulphate per acre are called for, and on the slightly acid mucks, 100 pounds.

This is not a place for a "shot-gun" mixture supplying small quantities.

A need for zinc under certain con-



Courtesy Campbell Soup Research Laboratories

Fig. 3. These rutabagas were grown on sassafras fine sandy loam with pH 6.2. They represent two plots, both of which received 1,500 lbs. of 5-10-10 per acre. The rutabagas with the dark centers received no borax, while those with the light centers received 40 lbs. of borax per acre.

ditions is showing in occasional instances. Certain new fungicides containing zinc have helped establish this. On crops that are regularly sprayed, the farmer may be wise to include zinc in his spray program rather than in the fertilizer, since zinc in the fertilizer does not give as consistent results as it does in the spray. For crops that are not sprayed and which need zinc, it will have to be incorporated in the fertilizer. It is not known how widespread zinc deficiency is. Five years ago it was not thought that there was any, and it is by no means certain now that any appreciable acreage in the Northeast is involved.

Dr. Hester and his associates in the Campbell Soup Research Division have some experiments in which they have demonstrated that if the nutrients contained in manure are applied in inorganic form, just as good results as with manure will be obtained. The manure they used contained 12 pounds of manganese, 15 pounds of iron, and 0.07 pounds of copper. Dr. Hester also feels that there should be at least 5 pounds of borax in a ton of fertilizer.

Magnesium has not been mentioned because in most areas in the Northeast it is supplied in dolomitic lime at small and often no additional cost over high-calcium lime. Fertilizer grades containing it are also available. To supply these quantities of micronutrients represents a substantial cost—too much, in fact, to add them to all grades without the backing of the State Agricultural Experiment Stations. At present it would be difficult to get any agreement from Experiment Station workers on the make-up of a micronutrient mix.

While the use of these micronutrients is fascinating and has the glamour of something new, it should not be forgotten that the most important mission for the betterment of agriculture still is the supplying of the major plant foods at a price that will enable the farmer

to fertilize for near maximum yields at reasonable cost. Additional research on this micronutrient problem is needed. The problem is present, but it is not known how extensive it is. Most state recommendations now read, "See your County Agricultural Agent if you suspect you have a micronutrient deficiency." This is putting many county agents on the spot without helping the farmer, since the county agent all too often does not have sufficient information to permit him to give a positive prescription.

The Lactic Litany

(*From page* 5)

At the receiving door a delicate scale is used to weigh each batch of milk dumped there. Time was when milk was counted only by the canful measure. Bureau of Dairy Industry tests made at a city intake on 346 shipments indicated that by can estimate there should have been 6,185 gallons, but upon a careful weight analysis at 8.6 pounds to the gallon, only 6,068 gallons arrived. This meant a shortage of 117 gallons. This inaccuracy was attributed to the dented and battered cans, leaks or spills, and incomplete filling.

AT the time of weighing, testers sample the milk and run butterfat and acidity tests, or they make plate counts or methylene-blue bacteria tests, having special laboratories for this work. Thence into the plant in question goes the whole milk from that silly old ignorant cow, a product practically untouched by human fingers. First and foremost at all types of milk plants, the fluid stream gurgles and boils into a cylindrical storage tank, often lined with glass. For processing into fluid form for cheese or for dry milk and evaporated milk, the second step in the glittering parade of the droplets is through clarifier or filter.

Enclosed patent filtering machines are used at all the major plants where the dairy business booms. The clarifier takes foreign particles from the milk by centrifugal force, and for most operators is preferred to a simple filter —except on a cost basis.

Two other indispensable gadgets are seen on larger dairy floors—the homogenizer and the pasteurizer. The homogenizer is no new thing, but it is widely used for market milk. Its mechanical agitation breaks up the small fat globules so they cannot bunch up together and form the well-known cream line at the bottle top. It is claimed that the milk is less affected by oxidation than untreated milk, will hold its flavor longer, but is sensitive to bright sunlight.

Pasteur himself gave the familiar name to the milk machine called a "pasteurizer." Essentially then, it is a bacteria killer. That's why we hear so much argument over using raw milk for drinking or for making butter and cheese—always tipping our battered hat to the exacting producer of so-called "certified' natural milk. (If you ever operated one of those fancy places you'd know all about the headaches in the milk muddle.)

EVERY up-to-date, particular commercial plant runs a modern pasteurizer. It may be a flash process pasteurizer or a holding type. This means maintaining the milk at 143° F. for 30 minutes, or at not less than 160° F. for about 15 seconds. Besides ridding the milk of its nasty bugs (less apt to be there than of yore) the process helps to

keep the fluid longer in palatable shape owing to the absence of lactic-acid-forming bacteria. To control the whole process definitely, intricate thermostatic automatic devices are found in tiptop plants.

You can wander at will and with astonishment through the larger plants and see tubular coolers, cooking vats, presses, hot wells, vacuum pans, drop tanks, driers, bottlers, packaging machines, and other stainless steel robots that handle the milk as it is pumped and forced along through stainless steel pipes.

These valuable adjuncts to your welfare afford a varied and a steady market for aluminum, antimony, bismuth, brass, bronze, cadmium, chromium, copper, lead, manganese, molybdenum, nickel, tungsten, vanadium, zinc, wood, glass, rubber, cork, and plastics. In the laboratories where the milk is tested, precision instruments add another touch to the complex scene and make still another market for the artisans of the world. Verily, that cow with her dreamy eyes and everlasting cud really started something despite her vapid disposition.

Although dairymen have invested fortunes in machinery to run these mammoth plants, they still require men to run them. The human element, the personal factor, is vital. Next to the arrangement scheme within the plant and its engineering features, the ability of the manager and the skill of the force determine the eventual success or fizzle of the enterprise and the ultimate satisfaction of the consumer.

LIKEWISE on the farm and in the country factory where small volume is handled, it takes brains and experience and a heap of faith and tradition to meet the above requirements of economy and quality. Nobody ever got a tip from the cow herself or very much sound advice from the guy who drinks the milk or nibbles at the cheese wafers. Like all American enterprise, it's the man behind the gun who must aim high and hit the target.

Some plants that take in only 1,200 gallons of milk per day will need 3 men —others of like volume require 6 workers. In the big buster outfits of over 20,000-gallon capacity daily the force may vary from 60 men to 130. Size doesn't make a good product either, taken by itself. I know tiny shack-like enterprises away out in the sticks that have earned a wide reputation for wholesome, tasty cheese which few of the gargantuan shops could even imitate.

ONE peculiar point so often forgotten about milk plants is that nobody can whistle for them to stop and start. Most of them just go on forever. Like the moo-cow herself, the white flood of milk can't be turned off at will and switched back again next Monday morning, or the day after the ball game. When the price for some other goods turns down and the boss scowls and gives the crew a vacation, your milk plant must keep on skimming and smiling, regardless of the price of cheddar or the cost of steel ingots.

Finally, after all the toil and trouble in the wake of the cow's tail on the road to the table—the greatest change of all perhaps is in the final selling thereof.

I can recall with dim repugnance how the milkman came daily to our door in the 1890's. His tottering hack rattled down our street and he rang a copper bell to notify the housewives to come hither with their pitchers. He claimed to be our friend, but sometimes I wonder!

Mother held out her jug or pitcher while Mr. Jones dipped frothy milk of a pale bluestone hue from a rusty can in the back end of his sagging wagon. He had no ice and neither did we. The milk had to be drunk that day or used to make pancakes, clabber pudding, or cottage cheese. Butterfat readings were unknown and bacteria and flies got their fill before we did.

Sometimes downtown a drugstore would shake us up a flat-tasting milk drink, and sometimes we enjoyed an ice cream "sociable" on the church lawn. Otherwise there was nothing doing in dairyland. Of course those who kept a backyard bovine before the city dads got so finicky about sanitation were able to wrestle themselves up a freezerful of lumpy ice cream on Sundays, or slop around with an old dash churn to coax the fat globules into forming a bit of streaky butter for us.

But now they chatter widely about contacts and luxury attractions at the "point of sale." Every street in every town boasts its soda fountains, bobtail milk bars, refrigerated cabinets, and automatic vending machines—and we buy milk in heavy cardboard or fiber containers, inhale it through straws, munch it in cones, and enjoy it in Eskimo pies.

AND lo, of a summer evening on my city street I hear again the sound of a dairyman's bell. But this time it is the motor vehicle bearing its dry-iced load of frozen pints and quarts. From every direction come the children and the women seeking a quick dessert for tomorrow's meal.

Yes, the cow has come home to roost once more. She is my neighbor and my friend, the foster mother of the so-called human race, the nurse of countless famished kids, the balancer of diets, the sign manual of health.

But believe me, it "ain't her fault." If we had no busy and ambitious men of daring and inventive mind and no capital willing to take a risk and bet on bossy, I am here to tell you that we'd be right back where we started—trying to keep well on salt pork, navy beans, and taters and gravy.

Here's to your health in a long, cool drink of you know what to wash down that sandwich, spread with the natural yellow product derived from a contented cow. That's just the same as wishing you a long life and freedom from ulcers.

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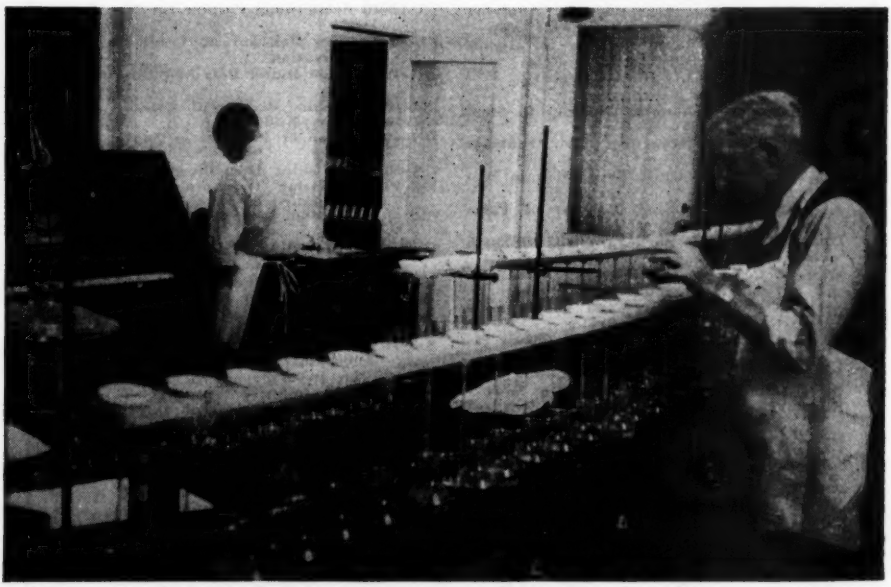
Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.



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Joe's wife caught up with her husband in a bar, sampled the highball he was drinking, and demanded, "How can you drink such horrible stuff?" "See!" said the husband, "and all the time you've thought I was out having fun!"

* * *

Mr. "Teaching that calf to drink took me two hours, roughly speaking."

Mrs. "That's what you may call it, John, but I'd call it plain cussing."

* * *

Visiting Nurse: "Did you drink three pitchers of water and stay in bed like I told you?"

Patient: "I drank the water."

* * *

The boss was working diligently in his office when his beautiful, blonde, 110-pound secretary walked in. The young lady was about to hand him the morning mail when she tripped, lost her balance, and sat squarely on his lap.

The boss roared like a lion, dumped the beautiful blonde unceremoniously on the floor, screamed that she was a clumsy good-for-nothing, ordered her out of the office, and told her she was fired.

Now you tell one.

* * *

A Farmer's Wife had lost her mind. As they carried her away in a strait jacket he said: "I jest can't figger what got into her—she ain't been outta the kitchen in 30 years!"

We wonder—if all horses say "Neigh," where in the world do little horses come from.

* * *

Gal: "Gosh, can't you be good for five minutes?"

Gob: "Say, sister, I'll be good for twenty years yet."

* * *

A colored lady was asked if she had ever been X-rayed.

"No, sah," she replied. "But I has been ultra-violated."

* * *

We're not surprised that the quintuplets have learned to swim, if they all slept in the same bed.

* * *

MOTHER IS JUST RIGHT

The day before last Mother's Day, a small boy, money in fist, entered a department store and timidly approached a woman clerk.

"I want to buy a present for my mom," he said. "A slip," he added, somewhat embarrassed.

"What size does she wear?"

The young man was really flustered. He admitted that he didn't know anything about sizes.

"Well," asked the sales girl, "is your mother tall or short, large or small?"

"She's just right,' said the lad firmly, and the girl wrapped up a size 36.

The day after last Mother's Day, the boy's mother came into the store with the slip and quietly exchanged it for a size 52.

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A new four-reel series of 16 mm., sound, color films which may be booked independently or in any combination. They may be used to best advantage when shown at least one day apart and in the following sequence:

THE PLANT SPEAKS THRU DEFICIENCY SYMPTOMS pictures soil depletion, erosion, and deficiency symptoms on plants. (Running time 25 min. on 800-ft. reel.)

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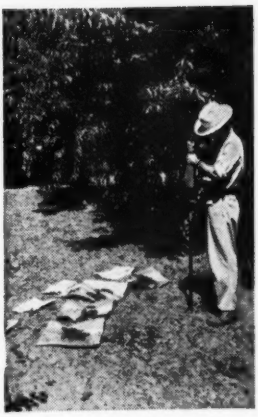
THE PLANT SPEAKS THRU TISSUE TESTS shows the value of tissue testing and the procedure for testing plant tissues in the field. (Running time 14 min. on 400-ft. reel.)

THE PLANT SPEAKS THRU LEAF ANALYSIS evaluates leaves in plant growth and leaf analysis in determining fertilizer needs. (Running time 18 min. on 800-ft. reel.)



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